JOURNAL

VOLUME 85

MAY
1961

Publications Committee

Chairman, C. W. HERD, B.SC., PH.D., F.R.I.C.

Secretary and Editor, F. W. GIBBS, PH.D., D.SC., F.R.I.C.

Administration

Secretary and Registrar

H. J. T. ELLINGHAM, PH.D., A.R.C.S., M.I.CHEM.E., F.I.M., F.R.I.C.

Assistant Secretaries

Administrative

D. A. ARNOLD, F.C.I.S.

Scientific

F. W. GIBBS, PH.D., D.SC., F.R.I.C.

Assistant Registrar

L. W. WINDER

Education Officer

D. G. CHISMAN, B.SC., A.R.I.C.

Finance Officer

J. F. HARDING, A.C.I.S.

Journal Subscription

30s. per annum (post free)
3s. 6d. per single copy

Advertisements

Miss H. M. A. GARDEN,
30 Russell Square,
London, W.C.1

THE ROYAL INSTITUTE OF CHEMISTRY

Patron H.M. THE QUEEN

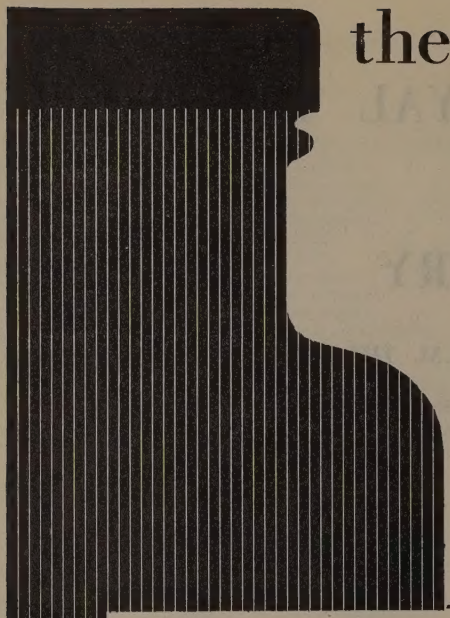
President SIR WILLIAM SLATER, K.B.E., D.SC., HON.D.SC., F.R.I.C., F.R.S.

	PAGE
Planned School Science, *by E. H. Coulson*	161
Catalysts for Progress, *by E. LeQ. Herbert*	163
The Soil—Problems Raised by its Use and Misuse	168
Current Instruction in the Use of Chemical Literature, *by R. T. Bottle*	173
Book Reviews	175
Institute Affairs	182
Examinations	182
Annual General Meeting	182
Meldola Medal Award, 1960	182
Personal Notes	183
Officers and Members of Council, 1961–62	186
Section Activities	187
News and Notes	202
Correspondence	205
Obituary	206
The Register	206

The Institute is not responsible for individual opinions expressed in articles and reviews or in reports of lectures and discussions. Editorials do not necessarily express the views of the Council.

THE ROYAL INSTITUTE OF CHEMISTRY, 30 RUSSELL SQUARE, LONDON, W.C.1

Langham 3482



the outstanding purities of **Judactan** analytical reagents

We invite you to compare the actual batch analysis shown here, with the purities guaranteed by the specifications to which you normally work —we are sure the comparison will be helpful to you.

SODIUM THIOSULPHATE A.R.

$Na_2S_2O_3.O5H_2O$ Mol. Wt. 248·19

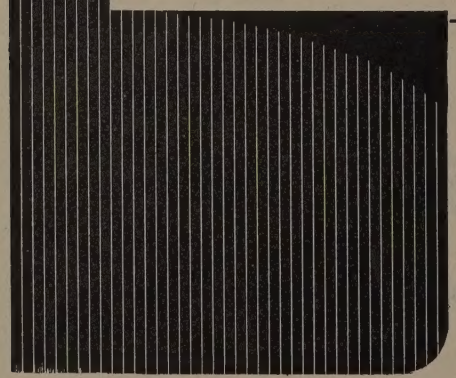
ACTUAL BATCH ANALYSIS

(Not merely maximum impurity values)

Batch No. 76714

Calcium (Ca)	0·0002%
Heavy Metals (Pb)	0·0004%
Iron (Fe)	No reaction
Reaction (10% solution)	pH6·7
Sulphate and Sulphite (SO_4)	0·001%
Sulphide (S)	No reaction

The above analysis is based on the results, not of our own Control Laboratories alone, but also on the confirmatory Analytical Certificate issued by independent Consultants of international repute



This is the analysis of a Judactan reagent. And, as with every other reagent in the series it is the *actual batch analysis*—it is one of several of which we are specially proud.

THE GENERAL CHEMICAL CO. LTD.

Chemical Manufacturers, Judex Works, Wembley, Middlesex.

PLANNED SCHOOL SCIENCE

This is not the only country in which fresh thinking is being brought to bear on the teaching of science. With characteristic energy and enviable financial assistance from the National Science Foundation, the school and university teachers of America have initiated two major contributions to chemical education—'The Chemical Bond Approach' directed by Professor Laurence E. Strong and 'The Chemical Education Materials Study' under Professor Glenn T. Seaborg. By any standards, the achievements of these two groups are impressive. The time is now opportune to review developments here and in the U.S.A., as they may profoundly affect educational policy in the future.

In November, 1957, the Committee of the Science Masters' Association issued a Policy Statement in which it was claimed that the science subjects should be regarded as essential ingredients of a complete education, and given the same status as English and mathematics. This statement, and some of its implications, was discussed in this *Journal*.[1,2] The formulation of syllabuses in biology, chemistry and physics to implement the statement is now complete, and these, together with a revised version of the Policy Statement, were published in February of this year.[3] The Association of Women Science Teachers has been closely linked with all these activities.

The new syllabuses, which were widely discussed in draft form, differ in many respects from those in current use. In the main they are concerned with science as taught in grammar schools, but much of the elementary matter in them could usefully be assimilated into the modern school curriculum. Common to all is the assumption that the first five of the traditional seven years of the grammar school course should be devoted to education for citizenship. This is an approach which might well be made in other subjects; its adoption would provide a refreshing and stimulating change from the present tendency to treat each 11-year-old pupil as a potential honours graduate in every subject. In the opinion of the two Associations, specialization can properly be retained for the last two years of the course, but must be confined to these, and sixth-form syllabuses are framed in recognition of this principle. The important problem of science courses for sixth-form arts specialists is being considered separately.

The presentation of chemistry as a 'core' subject in the education of all pupils is dealt with in the Introductory and Intermediate Phases of the syllabus. The objectives here include an appreciation of chemistry as a human activity, and of the contribution it makes to general culture. For this a much more flexible treatment is proposed, in which theory is considered as changing and corrigible, modern ideas are not neglected, and much of the nineteenth-century classical theory is discarded as being too difficult at this stage. The approach is empirical and experimental, with theory arising as the need for it becomes obvious, and with practical work leading to an awareness of the joy of discovery rather than the verification of principles presented *ex cathedra*. A good deal of organic chemistry is included, so that discussion of drugs, dyestuffs, plastics and so on becomes possible. The old 'preparation and properties' method is largely abandoned in favour of the study of reactions which can be linked usefully with underlying theory. Electrolytic processes, and ionic reactions generally, are given considerable prominence, and the simple picture of atomic structure necessary to deal with these is expanded, at the end of the course, to permit an elementary treatment of atomic and nuclear energy—possibly as a 'combined operation' with physics lessons. Not all the topics recommended can be treated rigorously, and some will not be susceptible to examination by conventional methods. The aims are to make chemistry teaching meaningful in the context of the present day, exciting and, above all, scientific, not least in the sense that major advances in science are impossible without the controlled use of the imagination.

The sixth-form course is covered by the Advanced Phase of the syllabus. This advocates a more systematic treatment on specialist lines, admitting, however, that a high proportion of the pupils studying the subject at this stage will not become professional chemists. Underlying principles are given careful and critical attention, with the choice of substances and reactions by which they may be approached and illustrated left almost entirely to pupil and teacher. The aims are awareness of a wide range of substances but detailed study of a comparative few, together with development of a judgment and discrimination in chemical affairs, and a much closer link between experiment and theory. In connection with the last of these it is significant that no mention is made of a practical syllabus of the type which leads to the conventional examination in volumetric and qualitative analysis.

What are the prospects for the new syllabuses? At sixth-form level, probably quite good; existing conditions are generally favourable and the need for reform is admitted. In the lower school, the way to progress will be beset with both real and contrived difficulties. There are very real problems of staffing, accommodation, laboratory and clerical assistance and so on to be solved. Also, however, there will be those who maintain that the new courses would be most desirable, if only we could 'afford' the time. Such an argument is totally without foundation and must be resisted strongly. Considering an average school week

to be of 35 teaching periods, we have 175 'year-periods' available in the first five years of a school course. Religious instruction and physical education might account for 15 of these, leaving 160 for distribution among the main subjects of the curriculum. What is a reasonable time allocation per subject? The panel responsible for the chemistry syllabus holds that the Introductory and Intermediate Phases of this can be covered adequately in 13 year-periods, provided that these are spread sensibly over the five years. One cannot assume that teachers of other subjects are less efficient than those of chemistry, so it would appear reasonable to treat all subjects on this basis, thus allowing 12 subjects to be taken at 'O' level. Educationally, the wisdom of this is most doubtful, but the possibility is there. The committee responsible for the revised Policy Statement has given much thought to this matter of time allocation. Doubtless for tactical reasons, the Appendix devoted to it recognizes the current dogma that some subjects are 'more equal' than others by allowing the languages and mathematics up to 60 per cent more time than the science subjects. Even so, this programme permits nine subjects to be taken at 'O' level, which would seem adequate for any future specialization. The general acceptance of such schemes as this would go some way towards meeting a plea made recently by Lord Boyd-Orr: 'Our whole educational system, which is still largely mediaeval with modern science grafted on to it, needs to be re-examined in the light of the new conditions with which the rising generation will need to deal.'[4] In the girls' schools the situation is especially depressing; for many the time allocated to chemistry is grossly inadequate. Whatever the solution to this problem, it is certain that the spirit of the new syllabuses will be lost if sufficient teaching time is not allowed for their development.

Much of the success of any syllabus revision depends on the examination system by which it is tested. Adoption of the new syllabuses will have major repercussions on the type of question set, and even on the method of examination. Practical work, too, will need to be re-orientated, and new types of experiment devised. These, and other matters incidental to the new syllabuses, are to be considered in future publications. It is hoped that progress with these will be faster than proved possible in the construction of the syllabuses, but this is very much 'spare time' work, and the resources of the two Associations are limited.

The first meeting of the steering committee of Professor Seaborg's 'Chemical Education Materials Study' was held in January of last year. Since then it has produced a three volume textbook plus two laboratory manuals, all of which are undergoing revision in the light of 'field trials' in selected schools. Teachers' courses are being held, a newsletter is in circulation, film and filmstrip programmes are under way, examination methods are being evaluated, and suitable monographs to supplement the basic text are planned. Twenty-five university and college teachers (mostly at professorial level) and a similar number of high school teachers are named as active participants in the venture. There are two permanent administrative staffs. One reads of 'a six-week writing session for nine university professors and nine teachers,' and 'a four-week teachers' course'. By autumn, 1963, it is expected that the material collected, having undergone its third revision, will be available to all interested schools, and that between 500 and 1,000 teachers will have been trained in its use.

Similar progress has been made, and is envisaged, by 'The Chemical Bond Approach' Committee. Together these two projects can affect American chemistry teaching in a manner which will be revolutionary. A couple of dozen picked school and university or technical college teachers could make a similar contribution to the future welfare of this country, given administrative help and some free time for thinking. Are we so barren of resources and so lacking in imagination that this cannot be done?

REFERENCES

1. 'Science and the Schools,' *J.*, 1958, 1.
2. E. H. Coulson, 'School Science and the Modern World,' *J.*, 1958, 67.
3. *Science and Education.* (A report issued by the Science Masters' Association and The Association of Women Science Teachers.) *Part One: A Policy Statement; Biology for Grammar Schools; Chemistry for Grammar Schools; Physics for Grammar Schools.* London: John Murray (Publishers) Ltd, 1961.
4. Lord Boyd-Orr, Presidential Address to the Science Masters' Association, January, 1961. *Sch. Sci. Rev.*, March, 1961, 203.

E. H. COULSON

CATALYSTS FOR PROGRESS

By E. LeQ. HERBERT, B.SC., F.H.-W.C., M.I.CHEM.E., F.INST.PET., F.INST.F., F.R.I.C.*

It is said that years ago one of the universities of China had a special way of conducting its final examination. The candidate was put in a large room, bare except for a table and a chair; food was supplied regularly, and equipment for writing without limit. Facing him as he sat, the one examination question was written large on the wall: 'Write down all you know'.

After my Presidential Address last year, when we met in Belfast, I felt somewhat as if I had come out of that examination room. Having been assured that there was neither rule nor precedent concerning two Presidential Addresses—some Presidents did give two, others only one—I thought it would be better for me not to go into that examination room as it were for a second time. So your original programme told you that we hoped to have Sir Harold Hartley with us this year to give the Conference Address. Unfortunately, just a few weeks ago Sir Harold was ordered by his doctors to rest completely for some months. Rather than search frantically at the last moment for someone worthy of this occasion and free to do justice to it, your President thought it best to use what short time remained for preparation and himself to perform this duty. I have not taken the title of Sir Harold's address.† I do hope that we shall one day hear from him what he makes of it; and I know I speak for all of you here today and indeed in the name of the Royal Institute of Chemistry, of which Sir Harold Hartley is a most distinguished Honorary Fellow, when we send him our sincere wishes for an early recovery.

With so little time left to me to prepare something—something which I hoped would be at least more than just adequate and yet having last year said all I could in a general way on my own particular industry (petroleum refining)—I was at first in a quandary. Then it occurred to me to try to link up with the general theme of our Symposium yesterday—'Chemicals from Petroleum'—and pay due tribute to that so-rapidly-expanding section of the chemical industry, and to show that the tribute is indeed due to chemical industry as a whole. So now let me explain to you my choice of title. The chemist calls the present time the age of catalysis. Catalysts are used to accelerate known reactions and by selective action on competing reactions to influence the direction of chemical change, and this in every industry where chemists can be employed. I have spoken at another time on the way in which the petroleum industry has become dependent on catalysts in the progress of the last 20 years. But the end of every chemical reaction which is exploited on the commercial scale is some industrial product, a super-fuel, a plastic, a solvent, a synthetic drug, an insecticide, fertilizer, synthetic fibre or what may be. I want to show how these products of chemical industry—many of them Chemicals from Petroleum—products often of catalytic reactions, are themselves harbingers and hasteners of change within the wider sphere of human history—*and* with wise guidance, hasteners of progress—*Catalysts for Progress*.

Left to itself human history can be slow. How many years elapsed between the invention of the spade to dig the first trench, which allowed water to flow inland from the river bank, and the first plough, which is faster than the spade?—or between the first wheel and the first carriage? And where communication was rare there can be little doubt that each invention was made many times in many places. So difficult it must have been for one community to benefit from the advances of another. Few of us imagine primitive man to have been happy; and it may be that we are inclined to exaggerate the happiness of industrialized and progressive society: but surely even the most cynical would admit that, by and large, progress has been in the right direction. Let me read to you, at least for its beauty of style, what Thomas Hobbes wrote of uncivilized man.

'In such condition, there is no place for industry; because the fruit thereof is uncertain: and consequently no culture of the earth; no navigation, nor use of the commodities that may be imported by sea; no commodious building; no instruments of moving and removing, such things as require much force; no knowledge of the face of the earth; no account of time; no arts; no letters; no society; and which is worst of all, continual fear and danger of violent death; and the life of man, solitary, poor, nasty, brutish, and short.'

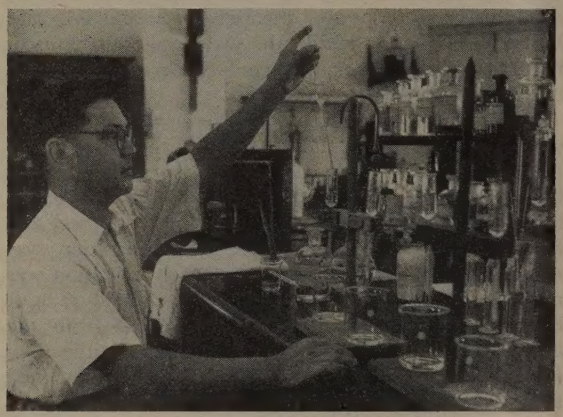
Now the direction of true progress is from that to its opposite; from life that is solitary, poor, nasty, brutish and short, to social, wealthy, healthy, cultured and long. Many influences that are not visible help to direct and control this progress: to ignore them is to adopt a purely materialistic attitude which I do not wish to do. But I do want to show the great part that is played in accelerating this progress by new things, products of chemical industry, and the great degree to which this progress is conditioned by them.

Those of us who are over middle age and whose business has taken us about the world have seen the transformation brought about by these substances with our own eyes. In many areas we have seen the ancient régime of endemic and degenerating diseases arrested by the use of therapeutic chemicals; and uncertain and

* Presidential address delivered at Southampton on 21 April

† The Workshop and Busy Depths of Nature

transient food supplies strengthened and become adequate by the use of pesticides and fertilizers; we have seen, too, many other products of chemical industry adding amenities to life that broaden the prospects of living. In short, within half a life-time, we have seen progress in the emergent territories that



Institute for Medical Research, Kuala Lumpur, where tropical diseases are studied

in our own country has a history of three hundred years and more. Such is the catalytic power of these products on those social reactions and rates of change that make for progress.

To illustrate this theme, the problem is one of selection rather than of search for examples.

For health I have chosen the treatment of three diseases—trachoma, a widespread disease of the eyes, leprosy, and yaws, a very severe skin infection.*

Trachoma is found in the sunshine regions—Southern Europe, the Middle East, wherever climate is warm, villages crowded and fresh water scarce. The disease is very infectious and leads to serious defects in vision and often blindness—one-seventh of the world's people suffer from it. It is a pathetic thought that in countries of such beauty it is the eye that is diseased. The cure is persistent, systematic use of ointment containing aureomycin. Children are treated at school and the news of prevention and cure spreads to the families. The cure is complete if this treatment is pursued vigorously enough, and we can look forward to the time when it will be banished from these village communities.

We now move to Central African villages where often leprosy abounds. Often bending of the fingers is the first sign of the dread disease; sores cover the whole body, and the victim is no longer active in society—a traditional object of shame and shunning. News of a cure always attracts; the whole attitude of sufferers to leprosy is more hopeful and it no longer carries the feeling of shame. The treatment is by injection of sulphone drugs over a long period of time.

Yaws is common in Thailand. It is a terrible disease, very infectious and characterized by red tubercules and running sores. It is said that 50 million people are infected with it. The cure is a big injection of penicillin—10 days after treatment the cure is already beginning and the sores are dry and healed.

Though in many countries to deal with widespread disease must have the first priority, nevertheless freedom from diseases is also a matter of hygiene and nothing can take the place of adequate, clean fresh water in the fight for health. There is no doubt, either, that the

The first essential for good health

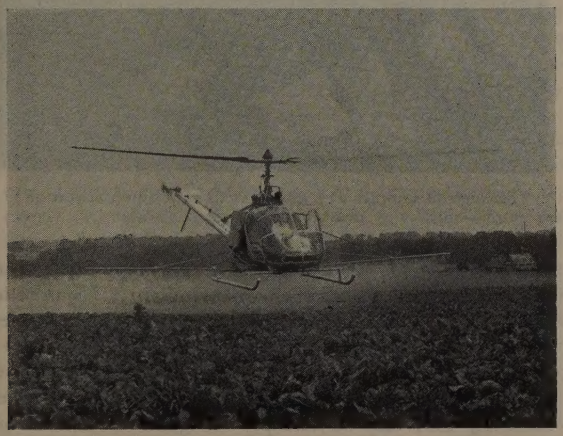
cleansing power of water is enormously increased by soaps and synthetic detergents—both of which are, again, products of chemical industry. The advantage of the synthetic detergent is that its effect is not reduced when the water is hard and production of scum or solid precipitate is avoided. Synthetic detergents are also available in great variety to suit practically every application. I will not burden you with statistics, but I would suggest that soap and detergent consumption up to 4 or 5 lb per person per year is a direct measure of hygiene and contributes directly to the health of the body. In many countries it is of course five times this figure and probably more than hygiene alone would require.

However good the soaps and detergents, hygiene is limited when water is scarce. I suppose chemists are still brought up on *The Physics and Chemistry of Surfaces*, the fascinating textbook by Professor N. K. Adam. There has recently been a remarkable application of those polar monolayers, in the study of which, in this

* The following three paragraphs were illustrated by a film sequence shot in Southern Spain (from 'Unseen Enemies').

University of Southampton, Professor Adam was for many years so devoted a pioneer. In the last year or two it has been found that a monolayer of cetyl alcohol or octadecanol on the surface of water reservoirs or natural lakes or pools can reduce surface evaporation and thus conserve the water. The amount of cetyl alcohol needed is said to be about 5 lb per acre per year, and the rate of evaporation from the surface may be reduced to 65 per cent, which means that the water lasts for a longer time. Practical application in India and Australia so far is reported to be successful; and there is no doubt that many other parts of the world are faced with this problem of water conservation.

An equally bold application of the physics and chemistry of surfaces is the seeding of rain-clouds with silver iodide or solid carbon dioxide so as to induce them to deposit rain. The silver iodide smoke is released from aircraft into the clouds. In this way rainfall can be controlled if there are clouds present. It is reported that Lake Corella dam in Australia was filled by this means. I quote from the Commonwealth (of Australia) Scientific and Industrial Research Organization publication as a welcome instance of clarity in scientific reporting: 'No control data are available for assessment of results, but clouds were seeded, rain fell, and at the end of the season the dam was nearly full'. I understand that many similar experiments have been made at various other locations but quantitative conclusions have not yet been reached. Well, here we seem to have a new frontier. I do not need to stress the dependence of human habitation, still less of human progress, on an assured minimum rainfall.



Spraying sugar beet for aphis control

Now I will turn to the second main example of my theme—food supplies. Health itself is little benefit without food, and the food must serve the purpose for which it was grown—in short, it must be protected against pests which destroy it, and it must be encouraged to grow by fertilizers.

With regard to the insects' threat to our health and our food supplies, let me just observe that there are about 2,000 million people on this planet and there are just about as many insects to *every square mile of land.* By no means all of them are harmful; but there are enough of them to cause half of all human deaths, and in a single year to deny us enough bread grain and rice to feed 150 million people. And they breed, as insects do—like flies which we know, or worse, like greenflies, a single one of which gives rise to progeny that (if they all lived) would outweigh the population of China within 10 generations. And a generation to them is *days*, not 30 years.

Forgive me if I claim lack of time alone as a reason for not going into the all-important role of chemicals in controlling insect-borne diseases the world over and allow me to pass straight to my one example from among the long list of insects who are rivals for man's food supply. I offer you the desert locust—the eighth plague of Egypt and a plague still over nine million

The eighth plague

square miles of Africa and Asia. Three hundred and ten million of the earth's inhabitants in more than 50 countries are subject to this threat to the destruction of their food supply. One medium-sized swarm must consume 2,000 tons of food a day to maintain itself. The cost of such must be counted in millions of pounds and, in the less fertile areas, in human lives lost by starvation*.

> The desert locust is hatched from the egg. At first it crawls and is soon eating fast. Each one of the swarm eats fast. Soon they begin to fly, leaving behind nothing but destruction and despair. The old

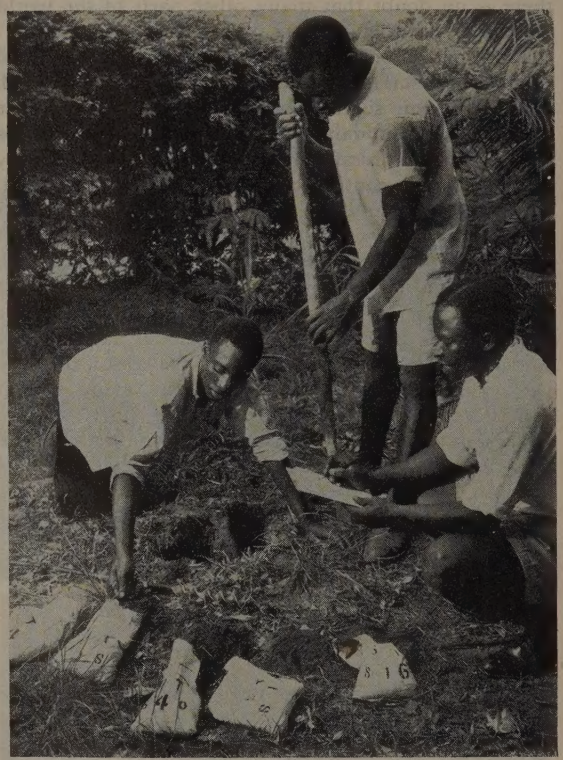
* The following paragraph was illustrated by a film sequence from 'The Rival World'.

Locusts cross the Tisi N'test Pass (Southern Morocco), leaving thousands dead in the snows

attack on locusts was confined to the crawling stage; attempts were made to beat them to death on the ground, but this was ineffective because if one in 50 survives a new swarm will soon breed again. But control is now possible—first by collecting intelligence about the formation of swarms and careful mapping of their movements; then the application of insecticides—bait-carrying insecticide is thrown to the locusts while in the crawling stage. Not all are destroyed in this stage but many are likely to survive to become flyers. The swarms may be over 20 miles long and five miles wide. Against these liquid contact poison is sprayed from the air, and it may take a week to spray a swarm with, for example, a solution of dieldrin in light mineral oil.

I think you will agree that this is a pretty forceful example of chemicals in the service of man. Now let me turn to another aspect of productivity—the use of synthetic fertilizers, which is another very direct application of chemistry. The great increase in the crops when synthetic fertilizers are applied to poor or exhausted soil is common knowledge. Firstly a representative sample of the soil must be obtained and the chemical analysis performed. The soil is frequently deficient in potash or phosphates or nitrogen, or it may be too acid. These deficiencies are the special ones that can be readily corrected by synthetic fertilizers. I am not showing the usual comparative photographs before and after use of corrective fertilizers because I am sure that you all have seen them very often. The exhaustion of good soil is so slow that in unindustrialized countries the farmer becomes used to, or perhaps accepts as fate, the poorer and poorer return for the same toil and beholds as if by magic how corrective treatment by fertilizers can restore the soil to a fertility perhaps known only to his forefathers. Of course, selection of better strains of seed has much to do with improving the crops by modern methods, but I wish especially to emphasize the part played by the chemical fertilizers. An increased sense of well-being is derived from seeing a greater result from the same amount of human toil; and the price of food, which regulates how much of it ordinary folk can buy, is largely a matter of how much labour is needed to obtain it. Under-nourishment is still the greatest handicap to full life and the basic condition for disease in many parts of the world.

So far I have been talking about the basic necessities of life—health and food. But many useful things and



Taking soil samples at a government experimental station near Ibadan, Nigeria

amenities of daily life are of course indirectly due to the inventions and products of chemical industry. Synthetic plastics are however a direct application, many articles being made entirely from them. Artificial textiles—nylon, Terylene and so on—are one instance and we can see others, useful and necessary things, as well as luxuries, that can be cheaply bought when made of plastic polymers. Plastics are received by a community when they bring benefits in service, or cost less in the long run.* The modern world is accustomed to a myriad of applications—from insulators to kitchen ware,

* At this point a film sequence, taken from several films on plastics, was shown.

chopsticks to telephones, from water-piping to specialized hospital equipment. And all in a great variety of colours.

Although the production of particular plastic polymers is done most economically in large units (with the result that more may be made than a single country requires), it is often economic and desirable to manufacture the articles from the plastic material in the country in which they are sold and employed. A local moulding factory can of course buy several kinds of plastic material—PVC, polystyrene, polythene, polypropylene and so on from several sources. Such factories operate today in Indonesia, Nigeria and in many countries of Africa. In Nigeria, to celebrate Independence Day in October last year, plastic beakers were manufactured locally in the country and duly presented to each of the schoolchildren. I am sure they have already lasted longer than the mug of earthenware or china that is the conventional coronation souvenir in England. Plastics, too, help to diversify the industries of a country —which is good : a country with industries all of one type may be at the mercy of the changing habits of mankind.

We must hurry on with perhaps a glance at preservatives and protecting agents. If things that rust and decay are made to last twice as long, the wealth that exists in them is doubled. Plastics are incorporated into paints and protective coatings of all kinds for wood, metal or building materials and to prevent attrition of cement and concrete by weathering or conditions of use. Wood preservatives to prevent loss by fungus, termites and insects of all kinds can be recommended with precision and applied with confidence. Bare mention of corrosion prevention is enough to feed the imagination of an audience of chemists in contributing to this theme. All parts of the world have these problems of corrosion and decay : and towards these corroding agents Regent Street in London is little safer than the primeval jungle. And as progress continues the benefits are universal; all countries may together receive the new methods of protection.

This brings me to something I want to say particularly to the younger members of this audience. No one, I think, would want to decry a proper patriotism; every man should—I would almost say *must*—love his native land; it is one of the springs of human energy and activity—but to the chemist the world is one world. He may be glad—if he is called to it—to spend his life's energy on foreign soil and on problems which his own country may never know. I may say more : the symbols of chemistry are international, for its development is not due to any one single country; and as with all other human learning its study and its application must increase the feeling of unity which all countries and races should share.

I am very conscious that this has been a sweeping view of the changing world through a chemist's eye—at least an industrial chemist's eye—but I hope you will agree that it is an exciting one and that there is ample evidence that products of chemical industry are increasing the pace of things for the better and that my title 'Catalysts for Progress' is justified.

There were times when the human notion of security was a static one; it rested on things *not* happening. A man liked to feel that if he put a thousand pounds away for 30 years it would still buy as much of the same goods as before; it rested on a serenity, an absence of disturbances, the idea that tomorrow would be as today and more abundant. There have been such times, but I am not sure that they were really good for mankind. Neither do I believe that our modern industrialized society is essentially insecure, because it does not produce the old and static idea of security. There was a sense in which the static idea was an illusion; it has in fact gone in many Western countries. For instance, a prosperous silk merchant or a worker in a silk industry might have had such comfortable feelings, say 50 years ago, in an industry centuries-old making a product generally esteemed and highly priced amongst mankind. The *pace* of things and new products of industry have in the last 30 years brought this old industry to ruin or at least to a state of hardship, and to the reverse of security in some countries.

We are coming, I feel, to a concept of *Dynamic Security*, the equilibrium generated by perpetual change, something like what the chemist calls Dynamic Equilibrium. There is no lawlessness in it. It means that every industry within Industry must be alive and moving, energetic and able to live with what changes come, ready to discard what is no longer productive and accept what is better. But not every new thing is viable in the competition of modern society, and so, more than ever, there is scope for every power of human judgment and awareness. The strength of modern industry is built on changing demands and circumstances, and its security is, I suggest, a function of its response to these things.

I end, therefore, with this idea of Dynamic Security depending on ceaseless action and reaction and endless change. Static security was essentially a local thing and could co-exist with neighbours insecure almost to the extent described by Hobbes's famous quotation. Dynamic security overflows to all around; the activity it rests on cannot be contained. And in this address I have again tried to put before you how general and world-wide these catalytic forces—these 'catalysts for progress'—are today and the great part played by chemists in the social history of our own times.

THE SOIL: PROBLEMS RAISED BY ITS USE AND MISUSE

On 15 March a Symposium on this topic, arranged jointly between the London Section of the Institute, the Institute of Physics and the Physical Society, and the Institute of Biology was held in the Senate House, University of London. Mr P. A. Raine, Chairman of the London Section, R.I.C., was in the Chair. Sir John Russell, O.B.E., F.R.S., opened the symposium with a paper on 'Soil as Nature Left it : Man's Use and Misuse'.

Two prime factors determine the natural suitability of a soil as an environment for living organisms : the chemical and physical nature of the underlying rock, and the climatic conditions under which it was formed and has since continued. The climatic factors cause the rock to disintegrate and some of its components to decompose, producing ultimately sands and clays, with loams as intermediates. The component particles of sands are relatively large and chemically inert : those of the clays are small, down to ultra-microscopic dimensions; the smaller ones are chemically reactive, forming among other decomposition products more or less soluble salts of potassium, magnesium and calcium, and also phosphates. The particles are irregular in shape and do not fill up the whole volume of a clod of earth; about one-half of it—the pore space—may be empty of solid matter, containing only air and water. Diffusion is fairly rapid and the soil atmosphere—at least in the surface foot—contains nearly as much oxygen as the air we breathe, though the percentage of carbon dioxide is higher, especially in undisturbed soils well covered with vegetation, such as grassland. The temperature of the top foot of soil follows the changes in the air above, but they are heavily damped, so that it is far more equable than at the surface. Water may occupy some 10 or 20 per cent of the total volume of the soil, or 30 per cent or more of the pore space. The force with which it is held depends on the size and shape of the pores : it may vary from very little up to many atmospheres.

Seeds of wild plants are so profuse and so widely distributed that a natural soil is rapidly colonized by plants suited to the conditions. When they die their roots, leaves and stems remain in the soil, returning to it the mineral nutrients they had taken up and giving it another component, organic matter—a source of food and energy appropriate for a host of living organisms. The point of chief biological significance is that the soil has supplies of air, water, food and energy—all that is needed to sustain low forms of life; and it seems to be a general rule that where these conditions occur the appropriate life appears. The soil becomes inhabited by an astonishingly wide range of living organisms from earthworms to bacteria. They include predators, even viruses; anything that can supply food and energy seems to harbour the kind of organisms that can deal with it.

Three sets of changes are of considerable importance : those resulting in the formation and decomposition of humus, those that result in the conversion of atmospheric nitrogen into protein-like compounds, and those resulting in the reverse change—the liberation of nitrogen from its complex compounds.

In natural conditions the various up-grade and down-grade reactions come to an equilibrium which persists so long as the conditions do not greatly alter : a position akin to the climax vegetation on the surface. The soil is richest in organic matter and nitrogen compounds when, as on many loams and clays, the conditions allow good plant growth (especially grasses) on the surface and the leaching by rain is not heavy enough to wash out too much of the soluble plant nutrients, particularly the nitrates and the calcium salts. It is poorest in organic matter when, as on many sands, the vegetation is more sparse and the soil porous enough to allow much leaching. So long as the conditions remain undisturbed the soil retains its level of plant nutrient content, *i.e.* its fertility.

When civilized man appears he removes the natural vegetation cover and so breaks the equilibrium. The organic matter is no longer renewed, and its percentage in the soil falls. During the process plant nutrients, including nitrates, become available so that for a time good crops can be obtained, but the yields quickly fall off, to the level of the new equilibrium. While the native vegetation remains undisturbed some of the plants, notably the grasses, are able to build up the soil particles around their roots into crumbs, improving it for plant growth and making it more stable against wind and rain. With the removal of the native vegetation the crumbs begin to disintegrate, rendering the soil more liable to erosion. This is one of the gravest misuses of soil and among the most serious problems of the day in great areas of the world, especially in the hungry countries : it can in many cases be solved but the solution is complicated by both natural and political factors.

Natural soils are rarely adequately supplied with plant nutrients, and as agricultural methods improve these deficiencies prevent them having their full effect. This defect is widespread even in the more advanced countries : fortunately the appropriate fertilizers are known.

The maintenance of proper soil–water relationships is an essential feature of correct soil use, particularly in regions of seasonal rainfall. Human requirements may

necessitate the felling of the forest and substitution of a crop. Investigations should, however, first be made to discover means of minimizing any harmful effects on the flow of springs and of rivers. The consequences of possible increases of the area under tea in Kenya are being studied from this point of view.

Another type of improper soil–water relationship results in bringing to the surface such large quantities of soluble salts, usually mainly sodium and magnesium salts, that plants suffer or are even killed. Great areas of irrigated land have been seriously affected and even rendered sterile in this way.

Much has still to be learned about the most effective ways of ensuring optimum utilization of soils, especially in the under-developed countries. The much-abused Colonial Powers have spent large sums of money and sent out many promising young experts to obtain and transmit this knowledge. It is not clear how far this work can continue.

SOIL FORMATION

Professor Taylor, of the Institute of Physics, then took the Chair and introduced the next three speakers.

Mr E. Crompton, of the School of Agriculture, University of Durham, said that a geological deposit consists of either a random distribution of mineral particles or an arrangement reflecting transient circumstances of deposition. Soil formation on such a deposit involves the rearrangement of the mineral particles and the inclusion of organic material in a manner controlled by the conditions of the environment, giving rise to a distinctive morphology known as a soil profile.

The five soil-forming *factors*—parent material, climate, organisms, relief and time—combine to condition certain physical, chemical and biological processes that occur in the soil itself and are the immediate mechanisms producing profile differentiation. These processes can be grouped under the headings of erosion/deposition, weathering, translocation and the organic cycle.

All sites on the earth's surface are subject to eroding and depositing effects due to gravity, wind and water, and they are constantly losing and receiving substances from the surface. At a particular site these mechanisms may be so vigorous that no soil profile can develop, or they may be of negligible proportions. Wherever a stable surface is established, differentiation begins through the local expression of the processes of weathering, translocation and the organic cycle.

The mineral particles of the geological parent material, which must contribute the greater part of the soil's inorganic constituents, consist mainly of silica, often combined with aluminium and iron, with generally smaller amounts of magnesium, calcium, potassium and, indeed, of most other elements. Moistened by rain-water, the primary silicate minerals undergo hydrolysis and pass into solution as ions, molecules or small colloidal groups. In this mobile condition they may combine to form new compounds, either close to the seat of weathering or after movement by diffusion or in percolating water to some other site in the profile, or they may be removed in the drainage water reaching the streams and rivers.

It has been shown that there are characteristic patterns of translocation, the chlorides and sulphates being relatively the most mobile in 'normal' circumstances, followed successively by the bases and the non-quartz silica, the iron and aluminium remaining under oxidizing conditions as a relatively insoluble residue of hydrous oxides together with the more resistant minerals, such as quartz and zircon. This general pattern of translocation may be altered (*a*) by the development of podzolizing conditions associated with an acid mor humus which hasten the movement of iron and aluminium, leaving a siliceous surface, and (*b*) by anaerobic conditions which lead to gleying, involving the reduction of iron and manganese and their increased mobility.

Whether the mobilized constituents are removed from the profile or combine to form new salts and minerals would appear to be controlled partly by the weathering/leaching ratio: if the release of constituents into solution is poor, due perhaps to low temperature or resistant rock, and the leaching potential is high due to continuous high rainfall, the soil solution is always too weak to encourage precipitation or crystallization and only the most insoluble products of weathering can avoid removal. On the other hand, if weathering is strong and leaching weak the soil solution may be relatively rich in ions released by weathering and they may combine to form new deposits, such as salts and clay minerals. The environmental factors combine to influence the richness of weathering and the intensity of leaching, and so pedogenic products should be characteristic of their environment.

Plants growing on the soil selectively extract inorganic nutrient ions from the root zone, transferring them to the surface either in their leaf litter or in the faeces and remains of the animals which have consumed the vegetation. This process modifies the pattern of translocation, and to some extent of weathering, and may also contribute new mineral products synthesized within the plant tissues. The remains of the plants and associated animals are decomposed through complex biological and chemical sequences to leave in the soil a residue of organic matter generally called humus, in which are combined, besides nutrients derived from the soil, significant quantities of carbon and nitrogen from the atmosphere. The organic cycle varies with the environmental factors, and thus the nature and distribution of humus in a soil profile presents features reflecting a particular environment.

The four groups of soil-forming processes are obviously capable of producing a great variety of combinations reflecting the geographical variety of the soil-forming factors, but it is suggested that in the world's soil cover

as a whole there may prove to be, besides discontinuities due to local geographical factors, natural groupings which are the result of relative discontinuities or variations in intensity inherent in the individual soil-forming processes.

PHYSICAL PROPERTIES OF SOIL

Dr H. L. Penman, of Rothamsted Experimental Station, regarded the soil (i) as a particulate system, (ii) as a porous system, and (iii) as a quasi-homogeneous system.

Particle problems arise in the weathering of soil (with pedological consequences in the formation of soil profiles, and chemical consequences in the release of plant nutrients); in clay mineralogy (from which stem studies of surface electrical charges, cation exchange, swelling and shrinking, and aggregate formation); and in studies of soil structure and its ability to withstand natural forces (wind and water), and farming operations, while permitting plant roots to expand and grow.

Pore-space problems are still more important. The biotic part of the soil needs living space, with water laid on, and some degree of air-conditioning. 'Soil water' is the most important single topic in agricultural physics. Soil porosity and structure determine infiltration rates at the surface, and permeability below the surface. Pore geometry governs the 'availability' of water for plant use (the relation can be expressed in thermodynamic terms) and also the movement of water (affecting both the driving potential and the hydraulic conductivity). The water potential may control the activity of the micro-fauna of the soil, and determine the possibility of their movement through the soil. Too much water is as unwelcome as too little; most plants need air space to permit diffusive exchange of carbon dioxide and atmospheric oxygen, and the rates are dependent on total pore-space, on pore size and on pore shape, all of which depend on water content.

Often, for description, and sometimes even for analysis, the soil can be treated as homogeneous, *e.g.* in thermal studies (where soil temperature and specific heat are meaningful terms) or in soil mechanics. Ultimate explanations must go back to particle properties, pore properties or both.

SOME CHEMICAL ASPECTS OF SOIL FERTILITY AND CROP PRODUCTION

Dr G. W. Cooke, of Rothamsted Experimental Station, said that the term 'soil fertility' means merely the capacity of a soil to produce the crops that are desired. Fertility is not absolute: soil that is fertile enough to support a good forest may be so poor that farm crops fail on it. The term integrates physical and chemical factors that influence supplies of water, air and nutrients to roots; in addition fertile soil must anchor plants satisfactorily and be easy to cultivate and penetrable by roots. Chemical aspects of fertility are concerned mainly with nutrient supplies and reserves, but physical factors that affect root growth and penetration must also be considered. The essential nutrients obtained from soil are Ca, K, Mg, N, P and S (the major nutrients), required in quantities of pounds or hundredweights per acre, and much smaller quantities of the micro-nutrients (from a few g to a few oz per acre) are needed, *i.e.* B, Cl, Co, Cu, Fe, Mn, Mo and Zn.

When the supply of one or more nutrients in soil is too small for full yields of crops that farmers wish to grow, *fertilizers* must be used to supplement soil reserves. Additions of plant foods to British farms through fertilizers and imported feedingstuffs are now greater than the losses of nutrients caused by selling crops and animal products. The nitrogen and potassium so added do little more than balance losses but the amounts of phosphorus added have been greater than the amounts lost for many years and the reserves of P in our soils are increasing wherever fertilizers are used heavily. Research on soil fertility is planned, firstly, to find out more about the reserves of nutrients in soils, to conserve them and to put them to best use; secondly, to find out more about the effects of fertilizers on crops and soils, and to help our farmers get the best value from what they spend (about £100m each year) on fertilizers.

Nature of nutrient reserves in soils

Nitrogen. The greater part of the reserve of soil nitrogen is combined with organic matter and is very stable. Reserves are depleted by oxidation, caused by continued cultivation; they increase by adding organic N contained in manures and in crop residues. The only *rapid* way of building up soil nitrogen in practice is by resting arable soils under grass. For any one set of conditions of soil type, climate, cropping and cultivation there is an equilibrium value for the proportion of total soil N; when the use of land is changed the proportion tends towards the value appropriate to the new conditions but changes are very slow and may need many years to be complete.

Phosphorus. Phosphorus fertilizers are also inefficient on a short-term basis, only 10–20 per cent of the dressings being taken up by crops. But in contrast to N, surplus P is not lost by leaching; phosphate ions combine with soil constituents and any excess of P accumulates in soil.

Potassium. The potassium ions added to soils by fertilizers move slowly down the profile, but in soils containing much colloid there is little or no loss by leaching until the exchange positions are saturated.

Calcium. Most of the immediately useful Ca in soil is exchangeable. Reserves are held as $CaCO_3$ in calcareous soils and also as a constituent of some soil minerals. Calcium is also very important in reducing the hydrogen ion concentration in soil. In very acid soils, Ca supplies may be deficient, but there is also a

risk that high concentrations of Al, Fe and Mn, toxic to plants, may develop.

Assessing nutrient supplies in soils and correcting deficiencies

Nitrogen. There is no generally-accepted chemical method of assessing the state of the soil N and so advising on fertilizers. Soils that are running down in N (*e.g.* when rich organic soils under old grass are cultivated for arable crops) release much more N than long-cultivated arable soils; to obtain full yields of crops on arable soils more fertilizer is needed than is necessary for the same crops where they follow grass. Work on laboratory tests for evaluating soil N reserves is promising; a chemical basis for modifying the current standard fertilizer recommendations that are derived from the results of agricultural field experiments should soon be available.

Phosphorus. Long-established field experiments at Rothamsted and a few other stations show that the reserves of phosphorus that accumulate in soil as a result of continued manuring may be sufficient for crops.

Potassium. The amount of exchangeable K is useful to know when advising farmers as to whether extra K should be given as fertilizer but the measurements do not reveal useful reserves of K.

Calcium. Ca is easily lost from the soil by leaching, and all non-calcareous soils tend to become too acid to be satisfactory for most farm crops. The remedy is simply to add liming material until the soil is nearly neutral in reaction. About 50 cwt per acre of $CaCO_3$ are lost in a 5-year rotation of intensive arable crops.

Magnesium. Deficiency of magnesium is responsible for little or no loss in yields of agricultural crops in Britain, but it is more serious in horticulture.

Sulphur. Many crops require as much sulphur as phosphorus. Sufficient is deposited in rain where S-containing fuels are burned and many fertilizers contain sulphates. These additions supply the needs of British crops but sulphur-deficiency is widespread in the U.S.A., Australia and New Zealand.

Micro-nutrients. The soil of practically all our agricultural land has enough of all the micro-nutrients, and deficiencies are very uncommon, except on a few areas of peat soils (where Mn and Cu deficiencies occur), and on very coarse sands where Cu deficiency has occurred. While common dressings of ordinary fertilizers are quite unimportant for replacing soil reserves of these elements, a dressing of farmyard manure once in the rotation will replace about as much of the micro-nutrients as farm crops remove.

Physical accessibility of nutrients

Physical effects influence nutrient availability; supplies of nutrients are useless if roots do not reach them. Most of the nutrient ions are not very mobile in soil and, therefore, roots must move to them. (Nitrate is an exception as it diffuses freely in the soil solution). To take up enough of the other nutrients, roots need to explore as much as possible of the internal surface of the soil, and any physical barrier to root growth reduces chemical fertility.

Dr Hopkins, Chairman of the Institute of Biology, who introduced the last three speakers, took the Chair at the evening session.

AGRICULTURAL PRACTICE AND THE SOIL FAUNA

Dr K. Mellanby, C.B.E., also of Rothamsted Experimental Station, pointed out that there is little accurate information about the soil fauna. To obtain accurate information is difficult in this dark, intractable environment, where extraction of fragile animals from rock-hard soil entails both hard physical work and the most delicate manipulation. Work on pests is given priority because of their obvious economic importance, so we know most about those animals which damage crop plants by eating them, distorting them or by infecting them with pathogens. We know how to control many pests and how cropping and cultivation affect their numbers. One advantage of crop rotation is that it may provide no suitable host plants for a pest which became epidemic in a previous crop.

We are still very ignorant about the vast majority of soil animals which are not pests. We have no accurate census figures for all animals even in such well-known areas as the Classical Experiments at Rothamsted. Even where we know something about the number and type of animals present, we seldom know exactly what they eat, and hardly ever how much they eat. Effects of climatic conditions on metabolism, feeding, movement and reproduction all require to be studied, and often we do not even know exactly the micro-climatic conditions to which the animals are exposed.

As a whole, cultivation decreases the soil fauna, particularly reducing the surface-casting earthworms. Soil insecticides may be very effective in eliminating pests like wireworms, but they may also cause a great rise in other insects such as Collembola, and we do not know how important this may be.

Earthworms often make up, in weight, much more than 50 per cent of the total weight of the soil fauna. Great importance has been attached to them in the economy of the soil, but there is still little concrete evidence to show their importance in agriculture. Different worms may have very different habits, so it is important to know which species of worm is present in soil. Those that make surface worm-casts, which are in fact the worm's faeces, produce Darwin's 'vegetable mould', *i.e.* the layer of stone-free top soil found in old pasture; it is another species which pulls leaves and grass down its burrows and so introduces organic matter into the soil.

FARMING PATTERNS AND SOIL-BORNE DISEASES OF CROPS

Dr S. D. Garrett, of the Botany School, University of Cambridge, noted that the control of soil-borne diseases of our farm crops is still firmly rooted today, as it has been for some centuries, in the practice of crop rotation, which has so many advantages, such as the parallel control of insect pests and weeds, that it is unlikely to be superseded in the foreseeable future. Research on soil-borne diseases is being directed towards the provision of ancillary methods to supplement the basic control maintained by rotation, to discover ways of shortening rotations, and to provide special schemes for intensive cultivation of particular crops.

The efficacy of crop rotation depends upon host-specialization of parasites, and it is the specialized parasites that cause the most important soil-borne diseases and those that are most difficult to control. The efficient practice of crop rotation implies effective control of weeds. The great majority of soil-borne diseases are caused by fungi or by closely related micro-organisms; some of these produce long-lived resting bodies (spores and sclerotia) and are hence difficult to control except by crop rotations of undue length. One possibility for the control of such diseases as clubroot of crucifers lies in the selection of 'decoy crops' of plants that provide the necessary stimulus to germination of the resting spores of the parasite, but do not permit infection to proceed as far as the production of a fresh crop of resting spores. Crop rotation cannot be expected to eliminate such diseases or any other ones completely from the soil, because the parasites can survive in a semi-dormant state in the subsoil, as well as surviving on occasional weeds and being reintroduced on infected planting material and by the natural agencies of wind and water. But crop rotation can be designed so as to keep parasite populations down to an acceptable level.

Reasonably satisfactory control of most soil-borne diseases can or will be achieved by a combination of crop rotation with various modifications in the pattern of crop husbandry, often in such a way that yields are increased even in the absence of disease, and so disease control becomes a bonus for good farm management. To achieve this end, research must provide, for each disease, full information about the effect of soil conditions on (1) the activity of the parasite on the roots of the growing crop, (2) the resistance of the crop to the disease, (3) the survival of the parasite in the absence of host crops. For (1) and (3), precise laboratory methods of experimentation have already given much information, which has been confirmed by field trials.

The general principles of disease control through modification of the pattern of crop husbandry will be illustrated by reference to two diseases of wheat and barley under intensive cultivation: the eyespot disease caused by the fungus *Cercosporella herpotrichoides* and the take-all disease caused by the fungus *Ophiobolus graminis*. The eyespot disease affects the tiller-bases and infection is promoted by a high relative humidity of the micro-climate at soil level; control can be obtained by the sowing of spring in preference to winter varieties of the two cereals, and by various crop husbandry measures, such as the reduction of seeding rate, that tend to reduce humidity of the atmosphere at soil level. Take-all is a disease of the root system; it can be checked by the preparation of a firm seed-bed and by care in the use of lime, so as to reduce the growth rate of the fungus over the root system, and by generous use of artificial fertilizers, to promote abundant production of new crown roots to replace those destroyed by infection. In between successive cereal crops, the fungus can be starved of the nitrogen it requires for survival in infected stubble by the growth of a leguminous catch crop. By the use of the 'Chamberlain system,' it is possible to take a continuous succession of spring-sown wheat or barley crops, undersown with a suitable legume, on the same land without serious risk that disease may develop.

CLIMATE AND EROSION

Mr G. V. Jacks, of the Commonwealth Bureau of Soils, Rothamsted, explained that four main factors are usually considered to determine the amount of man-accelerated soil erosion: (1) land utilization, (2) relief, (3) erodibility of the soil and (4) intensity of rain or force of wind. Of these, land utilization is the only one controlled by man and is by far the most important; and intensity of rain or wind is the only climatic factor. With natural erosion, uninfluenced by man's activities, 'land utilization', *i.e.* type of plant cover and soil erodibility, lose much of their significance except in regions so arid that a complete plant cover does not exist.

M. Frédéric Fournier, in *Climat et Erosion*, has attempted to find a relationship between the amount of water erosion (measured by the amount of silt carried in the river of a catchment basin) and certain climatic characteristics. He has shown that for a given type of climate and relief the amount of erosion varies with the square of the rainfall (p) of the wettest month, and inversely with the annual rainfall (P). The term p may be taken as a measure of the greatest expected intensity of rainfall.

It is remarkable that such a relationship could be established with quite a high degree of statistical significance, but the relationship merely expresses, with some mathematical precision, what has long been recognized—that water erosion is caused mainly by the impact of heavy rain on soil unprotected by a mantle of vegetation.

No comparable study of wind erosion and climate has been made, but it may be expected that wind erosion will vary directly with some function of wind

intensity and inversely with some function of plant cover, the density of which, up to a certain degree of climatic humidity, is in its turn a function of rainfall. Moist soils are not eroded by wind, so that for appreciable wind erosion to occur there must be a dry period sufficiently long to dry out the surface soil.

Fournier's data are mainly of normal erosion, unaccelerated by human activities. The influence of climate on accelerated erosion—the kind which concerns most users of soil—is, however, also indicated by Fournier's basic equation or, equally well, by common sense. In general, land which is used for agriculture carries a smaller plant cover at some period of the year than land which is running wild. If a period of reduced plant cover coincides with a period of intense rainfall or strong winds, erosion is likely to be intensified, whereas if the soil carries dense vegetation when heavy rains or strong winds occur, the likelihood of erosion is reduced.

It is questionable whether this relationship between climate and natural erosion can be improved on, and whether it has any practical significance. As Fournier recognizes, there are other factors—especially relief—that affect the amount of natural erosion in a region. The dominant causative influence in man-made erosion is undoubtedly a type of land use that leaves the soil unprotected or inadequately protected by a plant cover for considerable periods, and the aim of the farmer should be to see that his land is well covered by crops when heavy rains or strong winds are expected.

CURRENT INSTRUCTION IN THE USE OF CHEMICAL LITERATURE

By R. T. BOTTLE, B.SC., PH.D., A.R.I.C.

Bradford Institute of Technology

Taking the decennial indexes of *Chemical Abstracts* as a yardstick, primary information on chemistry has been increasing exponentially for the last 60 years[1]; the secondary sources, including reviews, monographs, reports, standard works and so on, do not appear to have lagged far behind. Faced with such a complex literature, it is only a very able student who can find his way around without some guidance. That these difficulties are being recognized is shown by the successful running of short postgraduate courses by the Liverpool College of Technology and LADSIRLAC and the inclusion of extensive courses in this subject in a number of Dip. Tech. schemes. Many American universities, however, have provided formal instruction in the literature of chemistry and other subjects for many years,[2] such courses even counting for credit towards the Bachelor degree.

To ascertain the present position in this country two surveys were carried out in November and December, 1960. The first to be completed concerned the 11 Colleges of Technology now running chemical Dip. Tech. courses (*see J.*, 1960, 304). The second survey was carried out by circularizing the Institute's honorary representatives in the universities (from the list appearing in *J.*, 1960, 255) with the questionnaire printed below and a short covering letter. Replies were also received from the University College of North Staffordshire and the Royal Military College of Science, Shrivenham.

RESULTS OF SURVEY

(1) *Dip. Tech. Courses.* Replies were received from all 11 colleges. Only three colleges give no formal instruction in the use of the chemical literature and two give only one or two lectures. Some of these five colleges implied that students were to become acquainted with such literature whilst carrying out their final year project work. The remaining six colleges make or will make what appears to be adequate provision for its teaching. Detailed syllabuses were obtained from three of these colleges, one of which proposes to give as many as 12 hours of lectures coupled with directed library work.

Where adequate instruction is scheduled, it is shared by librarians and chemistry staff (*cf.* the results of the universities' survey below). In several cases, the allied and equally neglected subjects of report writing and style were coupled with a course on the use of library facilities in general and the chemical literature in particular.

In my view, adequate instruction can scarcely be given in less than five or six lectures if the chemical information available in patents, government reports, trade literature, theses and other sources less obvious than 'Beilstein' and *Chemical Abstracts* is to be more than just mentioned. Much of the students' and the library staffs' time will be saved if the student is also taught to compile for himself a bibliography of any topic in which he may become interested, and where to find such bibliographic material critically reviewed. Contact, through well-balanced practical exercises, with the material described in the lectures is necessary if such courses are not to become sterile and tedious.

(2) *The Universities.* Out of a possible 38 replies, 37 were received; many representatives were kind enough

to amplify the information obtainable from the questionnaire by writing informative comments, some of which are reproduced below. The breakdown of the replies to questions 1, 2, 5 and 6 is given on the questionnaire. Question 3, on the number of hours of instruction given, produced the information that seven colleges give 1 hour; six, 1 or 2 hours; four, 3 hours; and eight an indeterminate time. Question 4, on the number of hours spent in directed or practical library work, showed that in 13 cases no practical work is set in addition to the lectures given, in nine an indeterminate time is spent in practical work, and one college specified six hours so spent.

The survey shows that two-thirds of the universities and colleges surveyed give some instruction in the chemical literature and its use, but that it is, in the main, confined to honours and/or research students. Only seven give any such instruction to general degree students who, perhaps by temperament and ability, are those least likely to ferret out such information for themselves. Often, where only one hour of formal instruction is given, the comments indicated that this is confined to the literature of organic chemistry, especially 'Beilstein'.

By contrast with the colleges of technology, only one college reported librarians sharing in the instruction. In fact, several commented that such instruction would not most appropriately be given by library staff, as in general they do not know the details of a technical inquiry.

The time-honoured expedient of setting students essays or short reviews to write after they have looked up references to the original literature is used in most universities. In some, this forms a valuable addition to formal instruction; in others, it is the sole method of introducing students to the literature of their subject. It is perhaps all the more remarkable that five establishments did not even use this method, as they were among those giving no formal instruction.

It is gratifying to note that a substantial majority (29) of the representatives thought that formal instruction was desirable, although this number includes four who qualified their approval. Regret was expressed that the chemical literature is yet another subject squeezed out by the pressure of undergraduate teaching. Only six representatives thought such instruction not desirable, one thinking it to be inessential 'in a big and flourishing research department where each generation of students helps the succeeding one in this.'

Several respondents were concerned lest formal instruction in the chemical literature should become dull and tedious; others stressed the need for reference books to be seen and used to be understood. This emphasizes the need for directed library work, which we have found so necessary for the successful running of short courses in this field.

It is hoped that the results presented in this survey will stimulate interest in, and discussion of, this facet of chemical education, which has hitherto received little attention.

I am very grateful to all those who have co-operated by supplying the information presented here.

REFERENCES

1. L. E. Strong and O. T. Benfey, *J. chem. Educ.*, 1960, **37**, 29.
2. See for example, J. E. Clemons, *Coll. & Res. Libraries*, 1956, **17**, 403; or L. W. Griffin and J. A. Clarke, *ibid.*, 1958, **19**, 451.

QUESTIONNAIRE

		Honours		General	
1.	Is formal instruction in the use of chemical literature (as outlined in the letter) given to	Yes	No	Yes	No
	(*a*) final year students, or	*22*	*13*	*7*	*30*
	(*b*) research students?	*16*	*15*		
2.	If instruction is offered, is this given by				
	(*a*) chemistry department,				
	(*b*) library staff,	(*a*)	(*b*)	(*c*)	
	(*c*) both?	*24*	*0*	*1*	
3.	Approximately how many hours are spent in such instruction?	.....	.....	.....	
4.	Does this include directed library work? If so, how many hours?	Yes		No	
		9		*13*	
5.	Is the student made to become acquainted with the literature by setting him essays or short reviews to write, rather than by formal instruction?	Yes		No	
		28		*5*	
6.	Do you think formal instruction in the use of the chemical literature is desirable?	Yes		No	
		*29**		*6*	

* Includes 4 in qualified agreement

Book Reviews

THE LIFE AND WORK OF WILLIAM HIGGINS CHEMIST (1763–1825). T. S. Wheeler and J. R. Partington. Pp. viii + 173 + xiv + 316 + 180. *Oxford: Pergamon Press Ltd*, 1960. 60*s*.

Just over 10 years ago F. A. Paneth drew attention to the fact that the *enfant terrible*, Frederick Soddy, had once again thrown a bomb among historians of science. The bomb had been smouldering since 1812, when Humphry Davy first threw it down at a meeting of the Royal Society assembled to hear the Bakerian Lecture: 'I have quoted Mr Dalton as the original author of the hypothesis that water consists of 1 particle of oxygen and 1 of hydrogen; but I have since found that this opinion is advanced in a work published in 1789—*A Comparative View of the Phlogistic and Anti-phlogistic Theories* by William Higgins. . . . Mr Higgins has developed many happy sketches of the manner in which (on the corpuscular hypothesis) the particles or molecules of bodies may be conceived to combine. . . .' The bomb thrown by Davy failed to explode, but has on several occasions since been found to be still smouldering. Though blown into incandescence by Paneth and Soddy, it was deftly thrown back by Professor Partington, who, however, had been sufficiently impressed by its destructive potentialities to collaborate with Professor Wheeler in an examination of its antecedents. The result of their astonishingly thorough work is the volume under review, which is of so comprehensive a nature that I may best serve the purposes of the prospective reader by analysing its contents.

The whole book consists of three introductory memoirs, followed by complete photographic reprints of two works by William Higgins, *A Comparative View of the Phlogistic and Anti-phlogistic Theories* (second edition, 1791) and *Experiments and Observations on the Atomic Theory, and Electrical Phenomena* (1814). The three memoirs are, 'The Life of William Higgins,' 'Higgins and the Atomic Theory,' and 'Higgins and Dalton,' each largely self-contained, with critical citations, commentary, and a documentary *apparatus*. Part III is supplied with a full index (incorrectly named 'Subject Index') to the whole original study, and, to assist the reader to form his own opinions, a concordance to the memoir on Higgins and the *Comparative View*, and conversely. Last, the *Comparative View* has itself been provided with an Index.

No more can be said about the two works reprinted than that the former stands on its own merits as the first *English* work to champion the 'new' chemistry, while the purely incidental remarks scattered about the text form the basis of Higgins's claim (in the second, much later, work on the *Atomic Theory*) to have 'anticipated' Dalton. The authors reject all claims on behalf of Higgins and at least by implication the more sweeping claims made on behalf of Dalton.

On any standards this is a massive achievement and a model of historical scholarship. Of the 'respective claims of Higgins and Dalton to be the founder of the Atomic Theory' it may well be 'a final and definitive treatment'. I would add that towards the re-writing of the history of atomism in the science of chemistry—now an urgent task—the authors have provided a timely and indispensable aid.

WILLIAM P. D. WIGHTMAN

THE BIOCHEMISTRY OF MUCOPOLYSACCHARIDES OF CONNECTIVE TISSUE. Biochemical Society Symposium No. 20. Edited by J. K. Grant and F. Clark. Pp. 125. *Cambridge: University Press*, 1961. Paper edition 15*s*; cloth edition 25*s*.

This publication records the proceedings of a symposium organized by the Biochemical Society on 13 February, 1960. Most of the important aspects of the group of substances known as mucopolysaccharides are described in a series of papers contributed by recognized authorities in each field. The papers are well documented, and include historical as well as current aspects of the subject. Discussions of the papers are included.

As the chairman stresses in his introductory remarks, the term 'mucopolysaccharide' has no generally accepted rigid meaning, but it is usually understood to include those complex polysaccharides, containing amino sugars and often acidic groups, that are associated with many animal tissues. This symposium includes only the acidic mucopolysaccharides, in particular those of connective tissue, and not those containing sialic acid, or the neutral members and mucopeptides.

The detailed chemical structures of the chondroitin sulphates (Muir) and hyaluronate (Rogers) are discussed, and current views on their function are described. Modern developments in carbohydrate chemistry have enabled considerable advances to be made in our knowledge of the structure of these compounds. Analytical methods employed for determining and identifying sugar components and polymers are discussed (Cardell), and a description given of the results of the application of recent chromatographic techniques for the purification of these complex polysaccharides. Their histological demonstration in connective tissues (Curran) and their enzymic degradation (Walker) are also considered.

A relatively new development in this subject concerns the biosynthesis of these complex molecules. It is known that nucleoside diphosphate sugars participate in the biosynthesis of sugars and polysaccharides, and aspects of this field that may be applicable to mucopolysaccharides are the subject of two papers (Storey, Kent), a particularly interesting feature being the mechanism for the entry of sulphuric ester groups.

The book presents an up-to-date account of knowledge in the field of mucopolysaccharides, and is valuable to all interested in chemical and biochemical aspects of the subject.

J. BADDILEY

A CONCISE QUALITATIVE ORGANIC ANALYSIS. G. H. Bottomley and F. E. Coleman. Pp. vi + 58. *London: Sir Isaac Pitman & Sons Ltd*, 1960. 6*s*.

The effectiveness of a practical textbook, especially an elementary one, can only ultimately be gauged by observing the results of large-scale trials in the hands of those for whom it was designed. Time, expense and other considerations must severely restrict the number of such trials but this book is certainly worthy of one, and is very modestly priced.

While the authors do not claim that the volume is comprehensive, its scope is nevertheless adequate for the majority of chemistry students in technical colleges. A concentration on essentials has led to the omission of less common types of compound. Some supplementary work may therefore be necessary for the final stages of Grad.R.I.C. and so on, but this arrangement should work better than the adoption of a more comprehensive work at the start of analysis with abridgements in the elementary stages.

The introductory sections give concise notes on the recording of results and the common laboratory techniques, with a detailed account of the elements test by the Lassaigne and Middleton methods. The observations and inferences to be drawn from them in the preliminary tests are straightforward and set out clearly and simply. The sections on hydrolysis and water-soluble acids—two subjects which often present difficulties to students—appear to be handled very well.

The melting-point tables condensed into three pages are probably the poorest feature of the whole book, and it would have been better to dispense with them altogether than give such an abbreviated version in small type.

Errors seem to be few, but the m.p. of 2,4-dinitrophenylhydrazine falls from 198° on p. 18 to 194° on p. 25, and there is inconsistency with bichromate (p. 16) and dichromate and carbon bisulphide (p. 20).

D. A. BAYLES

QUINONES IN ELECTRON TRANSPORT. A CIBA FOUNDATION SYMPOSIUM. Edited by G. E. W. Wolstenholme and C. M. O'Connor. Pp. xii + 453. *London: J. & A. Churchill Ltd*, 1961. 60*s*.

With the increasing interest in quinones and the growing realization of their importance in biochemical roles, the appearance of this volume could hardly be more opportune. It will provide the host of workers who were not fortunate enough to attend this Symposium, under the chairmanship of Dr K. Folkers, with a comprehensive account of current views and findings. Seventeen papers and two short communications are reported, with full attendant discussions. Many aspects of ubiquinone (coenzyme Q) are discussed, including its isolation and characterization (R. A. Morton, F. L. Crane); chemistry and related compounds (O. Isler, K. Folkers and their respective groups); roles in electron transport (D. E. Green) and in the respiratory chain (E. R. Redfearn); and five papers on various aspects of its biosynthesis (Rudney and Sugimura, A. J. Birch, F. Lynen, O. Wiss and co-workers, R. E. Olson and co-workers). The oxidation of quinols by mitochondrial preparations is dealt with by E. C. Slater and his colleagues, whilst particular reference to oxidation–reduction reactions of ubiquinone in heart and kidney mitochondria is also made (B. Chance). Histochemical studies of the effects of coenzyme Q_{10} and menadione on oxidative enzymes in normal and neoplastic cells are described by L. W. Wattenberg, and recent investigations on the chemistry and function of vitamin K by C. Martius. The importance of plastoquinone (Kofler's quinone) in photosynthesis, including a possible role in photophosphorylation, is dealt with by N. I. Bishop, and there are also papers on *in vitro* phosphorylation involving oxidation of quinol phosphates (V. M. Clark and Sir Alexander Todd) and on chroman formation and its role in oxidative phosphorylation (D. J. Russell and A. F. Brodie).

The only criticism of this excellently printed and produced volume is the lack of uniformity, from paper to paper, in the structural formulae.

D. WOODCOCK

NEUERE METHODEN DER PRÄPARATIVEN ORGANISCHEN CHEMIE. BAND III. Edited by W. Foerst. Pp. 326. *Weinheim: Verlag Chemie*, 1961. DM 14.50.

This volume continues the series of collected reviews from *Angewandte Chemie* (1958–1960) and contains articles on reactions of sulphur with arylaliphatic and aliphatic compounds (R. Wegler, E. Kühle and W. Schäfer); introduction of substituents into the pyridine ring (K. Thomas and D. Jerchel); olefins from carbonyl compounds by means of triphenylphosphinmethenes—Wittig-reaction—(U. Schollkopf); *N*-bromosuccinimide, its properties and reactions (L. Horner and E. H. Winkelmann); the acyl-lactone-rearrangement, a process for the preparation of heterocyclic rings (F. Korte and K. H. Büchel); syntheses with acid amides, particularly formamide (H. Bredereck, G. Gompper, H. G. v. Schuk and G. Theilig); syntheses with chloramin in organic chemistry (W. Theilacker and E. Wegner); preparation of esters, amides and anhydrides of phosphoric acid (F. Cramer); aromatic compounds from pyrylium salts (K. Dimroth); the introduction of the acetylene bond (W. Franke, W. Ziegenbeen and H. Meister); and syntheses involving diazoketones (F. Weygand and H. J. Bestmann). The reviews are in

the usual German tradition, well documented and with a strong practical bias. The book is obviously to be recommended to those with an interest in a particular field covered, but in addition a great deal of stimulating knowledge about some modern synthetic reactions can be obtained by browsing through the reviews.

A. J. BIRCH

MICROSCOPY OF RUBBER. C. H. Leigh-Dugmore. Pp. vi + 72. *Cambridge: W. Heffer & Sons Ltd for the I.R.I.*, 1961. 25*s*.

This is the latest of a series of monographs produced by the Institution of the Rubber Industry. Unlike some previous publications, the choice both of subject and author has been a happy one.

Almost every laboratory has a microscope, but all too frequently it is not used to the best advantage. The present volume will show how easily this state of affairs can be remedied in problems concerning rubber in the widest sense of the term.

After a short introductory chapter, chapter 2 (pp. 12) describes techniques both for the light, or ordinary, microscope and the electron microscope. This, as the reader is reminded, has been applied to the study of rubber structure since 1940. Here, as elsewhere, the author rightly confines his observations to those techniques which are special to the subject and hence not to be found in general books on microscopy.

Chapter 3, entitled 'Polymers' (pp. 18) will make this a valuable book for many who are not engaged in the rubber industry, since emulsion polymers are now widely used in other fields, for example surface coatings. The author shows how the microscope can give valuable information; it may even be used, as is explained, to follow reactions such as the hydrochlorination of latex.

The remaining chapters, on compounding (pp. 14) and properties of rubber (pp. 12), are more directly concerned with rubber itself but will, nonetheless, be of interest to all who have to deal with the dispersion of pigments or powders.

Adequate references to the literature are given throughout the book, and there is a good index.

This volume not only embodies the results of the author's unique personal experience, but contains much sound advice. The illustrations, 25 in all, are excellent. The price of the book is reasonable (members of the I.R.I. can buy it even more cheaply). It is well produced and may be unreservedly recommended.

H. J. STERN

ADVANCES IN CHEMICAL PHYSICS. VOLUME III. Edited by I. Prigogine. Pp. ix + 372. *New York: Interscience Publishers Inc.; London: Interscience Publishers Ltd*, 1961. 87*s*.

This volume continues the series of surveys of topics in the general field of chemical physics, though in some cases it is hard to distinguish between chemical physics and physical chemistry. As in earlier volumes, there is a pleasant mixing of theoretical and experimental work; this time, however, rather less space has been devoted to molecular structure analysis, and rather more to problems of thermodynamics. There are eight reviews. Most of them start at the beginning, and lead the reader to the latest published work. Unlike the papers in previous volumes, all these really are reviews, and not disguised original research. The mixture is so varied that the papers must be taken separately. Thus Elving and Pullman (pp. 32) discuss the mechanism of organic electrode reactions, and show how far calculations can explain the observed half-wave potentials, but it is still not known just how the electron transfer takes place from the electrode to the molecule. T. A. Bak (pp. 25) deals with non-linear problems in the thermodynamics of irreversible processes, in a chapter that almost overlaps with another (pp. 55) by S. Ono on variational principles in the thermodynamics and statistical mechanics of irreversible processes. Bak concludes that all this work, although interesting mathematically, has not yet led to much that could not have been got from the kinetic equations. Ono's review is a very substantial account of the use of variation methods in the principle of least dissipation of energy, production of entropy and transport theory. This chapter, it seems to me, is an excellent introduction to this field where, strangely enough, variational principles actually provide much of our physical insight. Hirschfelder and Curtiss (pp. 71) discuss the propagation of flames and detonations and illustrate their argument with many suitable diagrams. H. S. Johnston (pp. 40) discusses tunnelling in chemical reactions. This is important for H and D, and the author shows that simplified analysis can be used to predict classically the rates of many simple reactions. Quantum-mechanically, however, the position is very complicated, since the De Broglie wave-length along and across the potential energy valley is so large that the valley cannot be considered straight, and separation of co-ordinates is not valid. Pacault, Horace and Marchand (pp. 67) outline recent improvements in the measurement and calculation of diamagnetic susceptibilities. Tomassi (pp. 27) describes the interesting and not so very well-known development of powder electrodes largely occurring in Poland (it is a pity that the table of contents refers to them as power electrodes) and provides us with information about the electrical surface of a powder. Finally, Bastiansen and Skancke (pp. 40) survey electron diffraction work in gases and its relation to molecular structure. Bond lengths may now sometimes be estimated to within 0·003 Å by this means and wave-mechanical theories tested.

This collection of articles admirably fulfils the purpose of these annual volumes of Advances.

C. A. COULSON

PAPER ELECTROPHORESIS. A REVIEW OF METHODS AND RESULTS. L. P. Ribeiro, E. Mitidieri and O. R. Affonso. Pp. xii + 463. *Amsterdam: Elsevier Publishing Co.; London: D. Van Nostrand Co. Ltd*, 1961. 72*s*.

Although this book, first published in Portuguese in 1958, and revised and enlarged for its translation into English, is intended to be 'an account of the theoretical background of paper electrophoresis, and also a comprehensive review of the principles, techniques and application of the method', it also includes the agar and starch gel techniques. However, it is disappointing that only 18 lines have been devoted to high-voltage methods. Unlike many reviews of a rapidly expanding subject, it is not a series of disconnected accounts by numerous authors, and the standard of presentation, which is high, is therefore uniform throughout the text.

The contents, with three and a quarter thousand references, are indeed comprehensive, and appear to include all techniques published up to 1959. It is a pity that the authors did not provide a critical evaluation of the subject and of the relative merits of the techniques described; the reader in search of information therefore needs to make his own evaluation of the advantages or otherwise of the various methods. This is not a book to be read as a whole by the general reader, but is a mine of information for the analyst and research worker seeking reference material for a problem where electrophoresis may assist. Practically half the book is concerned with the plasma proteins, both in the normal and in the patient, and the clinical interpretations are adequately discussed. A short but interesting chapter describes the findings in animals, birds and reptiles. Enzymes, hormones, vitamins, nucleic and amino acids and inorganic substances each receive consideration in separate chapters, and the final chapter describes several special applications, including the porphyrins, bile pigments and viruses. There is a short account of the application of the technique to immunochemistry, a method likely to be of value not only to the pathologist but also to the endocrinologist, for whom immunological techniques will provide sensitive and specific methods of estimating protein hormones.

This book is not unreasonably priced, for it is beautifully produced and lavishly illustrated with unusually good photographs.

C. H. GRAY

RADIOACTIVATION ANALYSIS. (Proceedings of the Radioactivation Analysis Symposium held in Vienna, June, 1959.) Pp. 141. *London: Butterworth & Co. (Publishers) Ltd*, 1960. 30*s*.

The 12 papers with associated discussion collected in this volume have been reprinted from *Pure and Applied Chemistry*, **1**, 1.

The first, by Cook, introduces the subject, describing the by now well-known principles and practice, advantages and sources of error of radioactivation analysis. Attention is drawn to the possibility in some cases of avoiding chemical separation by the use of γ-spectrometry, a theme further developed in the discussion. Leddicotte's paper, a comprehensive review of American practice over a number of years, duplicates some features of Cook's paper.

A third review paper, by Lenihan, treats of the analysis of biological material, particularly from the viewpoint of the medical man. The extreme sensitivity of radioactivation analysis is of special value in this field where samples taken from living human subjects must often be small.

A contribution to non-destructive radioactivation analysis is provided by Ljungren in a paper on the application of coincidence γ-spectrometry using fast coincidence circuits. The determination of nuclides emitting positrons or γ-rays in cascade in the presence of other γ-emitters is described, *e.g.* ^{64}Cu in the presence of ^{24}Na or ^{137}Cs, or ^{60}Co in the presence of ^{59}Fe.

The determination of the age of rocks from a measurement of the ratio between their content of a radioelement and its stable end-product involves the determination of minute traces; Herr describes the application of radioactivation analysis to this problem with special reference to the work at the Max Planck Institute on lepidolites and meteorites.

Accurate results for the determination of minor constituents, up to a few per cent, in high-alloy steels are claimed by Hoste, who employs internal standards to avoid some of the uncertainties inherent in this method of analysis. Two portions of sample are irradiated, a known weight of the element to be determined, for example tungsten or vanadium, being mixed intimately with one of them. Gibbons and Simpson tackle a similar problem in the case of tantalum by irradiating dilute solutions of sample and standard.

Four papers treat particular cases of trace-metal determination, two of them as an aid to study of diffusion. One paper, by Leveque, is barely relevant.

D. A. LAMBIE

GAS CHROMATOGRAPHY 1960. (Proceedings of the Third Gas Chromatography Symposium held in Edinburgh, June, 1960.) Edited by R. P. W. Scott. Pp. xvii + 466. *London: Butterworth*, 1960. 95*s*.

This series of symposia on Gas Chromatography held in 1956, 1958 and 1960 forms almost a history of the development of this technique, which has grown like a chain reaction and has become in a matter of a few years one of the foremost techniques in chemistry and chemical technology. Professor E. L. Hirst in his opening address, however, reminded the conference that 'techniques are there for a purpose, and that it is the duty of a scientist to use these techniques for the solution of his own particular problem,' and how, too, chromatography in general has completely transformed the analytical

approach to the chemistry of natural products and, of course, many other fields as well. Summarizing the three symposia, one can say that the first one introduced the scientific world to the underlying principles of gas chromatography, and with comparatively crude equipment indicated the potential applications of the technique; the second showed a marked development of the theory and led to the use of capillary columns and refinements in the efficiencies of columns which, in turn, required highly sensitive detectors, as exemplified by the argon detector and the flame ionization detector; while the third might almost be known as the battle of the detectors, for much time was spent on discussing the relative merits of the argon and flame ionization detectors, and on the refinement of equipment which has reduced the time of operation from minutes to seconds. It is worth noting that the theoretical side was hardly discussed except where it had an impact on the technical improvements, and also there were few contributions from purely academic research groups. It is probably not wise to infer that academically the technique is not of interest, but rather that industrial research laboratories, having more ample technical facilities, can more easily carry out the developments.

After a brief report on the type of work carried out in Eastern Germany, the first section of the book begins with a summary of the controversial problems in gas chromatography, which are outlined without undue discussion. This is then expanded in subsequent papers to show the trends in the construction and operational difficulties when undertaking detailed investigations of the highly sensitive ionization detectors. Other papers deal with modifications of conventional systems in an attempt to solve problems of automatic industrial analysis, a new time–voltage integrator and the presentation of chromatograms on an oscilloscope.

The second section contains a brief but instructive report on the theory of the subject; this is followed by papers on the operating conditions for coated and nylon capillary columns; an approach to reduce analysis times; the temperature limitations of stationary phases; and the use of a classical organic chemistry reaction to aid the analyst to interpret his chromatogram. The methods one can employ to improve the efficiency of large-diameter columns and hence purify and identify complex organic mixtures are dealt with in two papers. Another paper describes in detail how the recommendations of the second symposium were acted upon to determine specific retention volumes of cyclic hydrocarbons. The final papers in the section show how weak interactions at unoccupied co-ordination positions in complexes may be used to retard molecules which can act as ligands, and the variation of retention time with molecular shape.

The final section, which is concerned with general applications, begins with an illuminating description of the developments in gas chromatography in the U.S.S.R., and then describes applications of the technique to the separation of metal halides; the analysis of inorganic halogen compounds; quantitative gas–solid chromatography of mixtures of nitrogen oxides; the apparatus for in-line analysis of corrosive gases; and the analysis of complex gaseous mixtures encountered in anaesthetic research. Other papers include those on the analysis of gasolines; the problems of medicinal white oil stability; the identification of organic substances by their pyrolytic cracking pattern; the analysis of vinyl monomers; and the final paper describes an apparatus for fuel-gas analysis.

Although the editorship of this book has changed hands, the traditionally high standards are maintained without question, and the volume presents a balanced account of the specialized literature on this important technique. The expertly reported discussions show the searching reader that the symposium was both controversial and instructive. F. H. POLLARD

RUSSIAN FOR SCIENTISTS. D. Ward. Pp. 204. *London: University of London Press Ltd*, 1960. 15*s*.

Many scientists who begin to study the Russian language find that the time and effort required are too great to be sustained in a busy professional or student life. This book is designed to help them.

The author steadily and gradually introduces the student to the Russian language and its grammar, and to the recognition of meaning in Russian phrases and sentences. Thus the first nine chapters deal with the declensions of nouns, the infinitive and past and present tenses of verbs. At the end of each chapter is an exercise consisting of Russian sentences for translation into English. A scientific vocabulary is used in the exercises and in the presentation of the grammatical forms. None of the exercises requires translation into Russian. Problems of vocabulary and syntax arising in the exercises are explained clearly in footnotes.

The tenth chapter deals with the aspects of the verb and the exercises from this point onwards are mainly passages selected from the *Transactions of the U.S.S.R. Academy of Sciences*. For a further nine chapters the author continues to outline the grammar of the language and illustrate it by translation exercises. The grammatical material is very clearly presented and constitutes the minimum required for the development of a reading ability of the language. The book ends with a vocabulary of about 2,000 words used in the exercises.

The work in this volume is carefully designed to enable the student who goes through it conscientiously to achieve the limited aim of recognizing Russian texts in his own subject in the shortest possible time. This is a result that such a student should certainly achieve, and in doing so he might find that he has laid the foundation for a more ambitious study of the language.

P. L. WYVILL

PRINCIPLES OF UNIT OPERATIONS. A. S. Foust *et al.* Pp. vii + 578. *New York: John Wiley & Sons Inc.; London: Chapman & Hall Ltd*, 1960. 120*s*.

The concept of the unit operations has formed the basis of chemical engineering teaching for nearly half a century. Indeed, it is probably true to say that the adoption of this system of classification of the processing methods employed in the chemical industry has been responsible for the recognition of chemical engineering as a science and an academic discipline.

For some years, however, there has been evidence of a wind of change blowing. It has been acknowledged for a considerable time that the underlying theories of such unit operations as absorption, distillation and extraction, for example, are basically similar, and that they are best taught together as one subject, *viz.* mass transfer. The applications of these theories to the individual unit operations can afterwards be discussed separately. This innovation is now taken a stage further.

The authors have classified most of the unit operations into two main groups—stage operations and rate operations. The fundamental theories applicable to these two fields are derived, discussed and then applied. The book is divided into three parts. Part I (pp. 74) deals with stage operations, that is those in which matter is transferred from one phase to another by discontinuous contacting. A generalized model of equilibrium-controlled processes is developed for application to any of the mass transfer operations. Part II (pp. 128) is devoted to a theoretical treatment of those operations in which some property of a phase diffuses or is transferred across a boundary under the influence of a potential gradient. The molecular and turbulent transport of heat, mass and momentum are considered.

In Part III, which is the largest section of the book, (pp. 282) the principles of equilibrium and rate processes, developed in Parts I and II, are discussed in relation to the individual unit operations. Amongst the topics mentioned are the practical aspects of heat transfer; mass transfer (packed towers); simultaneous heat and mass transfer (humidification, drying, evaporation, crystallization); and momentum transfer (pumps, compressors, and phase separations based on fluid mechanics). Two descriptive appendixes are included; one deals with units, dimensions, dimensional analysis and model theory, and the other with the measurement and description of particulate solids.

This book represents a considerable departure from the conventional texts on the subject. It is based on courses given over the past few years to undergraduates at Lehigh University, Pennsylvania. With this generalized approach to the unit operations, the authors claim that teaching time is saved and the fundamentals are more adequately presented. They admit, however, that this method of presentation can be more bewildering to the average student than is the traditional approach. But they hasten to add that after a 'short period' the material becomes clear, and the students ultimately gain a greater understanding of the unit operations.

All these things may be true, but I feel that this book can only be used to its fullest advantage when read in conjunction with a sympathetic course of oral instruction. A good deal of responsibility is placed on the teacher, for it is he who must supply the pictorial representations of the fundamental concepts. Otherwise, the student may fail to see the chemical engineering wood for the mathematical trees.

This extremely neat volume is well written, clearly illustrated and strongly bound. It is, however, rather large ($8\frac{1}{2} \times 11$ in), heavy ($3\frac{3}{4}$ lb) and, for the student, costly. In many ways this book is a pioneer; it has undoubtedly set the pattern for a new generation of textbooks on the unit operations. For this reason alone, it is well worth reading.

J. W. MULLIN

APPLIED THERMODYNAMICS. S. H. Bransom. Pp. vii + 230. *London: D. Van Nostrand Co. Ltd*, 1961. Paperback edition 22*s*. 6*d*.; cloth edition 30*s*.

The student seeking to master the elementary principles of thermodynamics is faced with a multitude of textbooks in which many different notations are used and the subject is treated from various aspects. In these circumstances he will be well advised initially to pin his faith to one book in which definitions and fundamental concepts are clearly set out and illustrated by practical examples taken from the field in which he is working.

Dr Bransom's book is addressed primarily to chemical engineering students, and seeks 'to develop physical concepts of the thermodynamic functions fundamental to physical chemistry and heat engineering and to stress the roles of the basic principles in the practical applications to chemical technology'.

The first three chapters give a conventional treatment of the first and second laws, with the appropriate definitions of intensive and extensive properties. The author does not at this stage introduce the fundamental equations by means of which all the thermodynamic functions can be expressed by one characteristic function and the corresponding independent variables; this omission leads to an incomplete understanding of the conditions necessary for a system to be in stable equilibrium. It also limits the scope of chapter 4, in which an account is given of the use of thermodynamic diagrams in tracing changes of state and energy in various processes.

Chapter 5 emphasizes the importance of a knowledge of the thermodynamic properties of real as distinct from ideal substances, and indicates a number of methods of 'generalizing' the data and of predicting properties when data are incomplete. It is to be regretted that

considerations of space have not allowed of a fuller treatment of multi-component systems.

In chapter 6 a brief account is given of fluid flow in pipes and nozzles, of two-phase refrigeration and of gas liquefaction. The free-energy functions are introduced in chapter 7, and their use is further developed in the succeeding chapter which deals with equilibrium states.

A full analysis of the process of distillation based upon the thermodynamic properties of the system is attempted in the final chapter.

A valuable feature of Dr Bransom's book is to be found in the examples and notes given at the end of each chapter. These are well chosen to illustrate the use of thermodynamics as a tool for the solution of a wide variety of practical problems.

D. M. NEWITT

HANDBUCH DER MIKROCHEMISCHEN METHODEN. VOLUME I. PART 2. Edited by F. Hecht and M. K. Zacherl. Waagen und Wägung, by A. A. Benedetti-Pichler; Geräte zur anorganischen Mikro-Gewichtsanalyse, by F. Hecht. Pp. 307. *Vienna: Springer-Verlag*, 1959. 136*s*.

This volume, by two writers whose names have been so closely associated with the development of microchemical methods, can safely be regarded as a comprehensive and definitive treatment of the two topics included in the sub-titles.

Dr Benedetti-Pichler's section on the balance and weighing occupies slightly more than half of the book, and falls into three sub-sections, dealing with precision and accuracy of weighing, microbalances derived from the conventional analytical balance, and microbalances involving principles other than those used in the classical balance.

Dr Benedetti-Pichler discusses in his first sub-section the theory of weighing, a subject on which he has for long been recognized as an authority. The construction, use and care of the conventional microchemical balance are treated in the second sub-section, which also includes a brief consideration of newer patterns such as the single-pan balance. The third sub-section describes a wide variety of torsion and spring microbalances, many of which are applicable to the ultramicro range. Beam-balances constructed from quartz fibres are also dealt with.

Professor Hecht's section of the book deals extensively with all the accessories necessary for micro-gravimetric analysis—vessels for precipitation, filtration, drying and ignition of precipitates, evaporation of solutions, and the like. A short account of the determination of the density of liquids is included.

Both parts of the book are comprehensive and, as one would expect, authoritative. They are fully and clearly illustrated, and numerous literature references are given. To anyone concerned with the classical procedures of analytical chemistry as applied to small samples, the book is invaluable as a compact and reliable source of reference for all aspects of gravimetric analysis.

CECIL L. WILSON

PRESSURIZED PACKAGING (AEROSOLS). Second Edition. A. Herzka and J. Pickthall. Pp. xii + 509. *London: Butterworths*, 1961. 70*s*.

The first edition of this work was published in 1958. In the intervening period the U.S. aerosol industry has grown to gigantic proportions, while in the U.K. this method of packaging has become widely accepted for a variety of products where this method of presentation has been found advantageous on either technical or commercial grounds.

During this time the book has been the sole reference work on the subject, and despite minor deficiencies has proved valuable to U.S. and U.K. workers in this field.

The new edition has been fully revised, particularly to include more complete data on both liquefied and compressed gas propellents, while much of the formulation information has been brought up to date in the light of practical experience.

The authors have now also included a section on the legal requirements in various countries, and a useful patent bibliography covering principally British and U.S. patents.

Apart from a continued tendency to quote American information—and this is perhaps still inevitable—the only major criticism arises primarily through the time currently taken to publish a major technical work. In this case the text is already nine months out of date, and it is singularly unfortunate as the industry and its technology are still undergoing active development in many directions.

If this book is to maintain its great value as a principal source of reference it will undoubtedly need further revision in another two or three years' time, and it is hoped that the authors will undertake this task.

I. GREENFIELD

PUBLICATIONS RECEIVED

ANNUAL REPORT OF THE CHEMICAL EXAMINER'S DEPARTMENT AND STATE FORENSIC SCIENCE LABORATORY, 1959. Pp. 22. *Madras: Government of Madras*, 1961.

NITROGEN PROBLEM. (Forty-Eighth Indian Science Congress, Roorkee, 1961—Presidential Address.) Professor N. R. Dhar. Pp. 32. *Calcutta: Gouranga Press Private Ltd*, 1961.

METALLURGY FOR ENGINEERS. Third Edition. E .C. Rollason. Pp. vii + 392. *London: Edward Arnold (Publishers) Ltd*, 1961. 20*s*.

CAWTHRON INSTITUTE ANNUAL REPORT, 1959–60. Pp. 37. *Nelson, New Zealand: R. W. Stiles & Co. Ltd*, 1960.

Institute Affairs

EXAMINATIONS, SEPTEMBER, 1961

Graduate Membership, Part II

Theoretical examinations will be held in London, Birmingham and Glasgow, and, if required, in other centres on **Monday and Tuesday, 11 and 12 September, 1961.**

Practical exercises will be carried out in London, and, subject to confirmation, in Birmingham and Glasgow on **Wednesday to Saturday, 13 to 16 September,** inclusive and in London on **Tuesday to Friday, 19 to 22 September,** inclusive.

Candidates will be asked to state their preference as to the centre for their theoretical papers and the period and centre for their practical exercises; but it must be clearly understood that no guarantee can be given that their wishes will be met.

Candidates who have not yet been accepted for examination and who wish to present themselves in September should obtain from the Assistant Registrar without delay the prescribed Application Form, so as to allow ample time for obtaining the necessary signatures certifying that they have complied with the Regulations concerning their courses of training. **The completed Application Form must reach the Institute not later than Monday, 5 June.** No application will be considered if received after that date.

Entry forms will be sent as soon as they are ready to all accepted candidates. **The last date for the receipt of Entry Forms is Monday, 3 July.** No entry will be accepted if received after that date.

ANNUAL GENERAL MEETING, 1961

The 83rd Annual General Meeting of the Institute was held in Southampton on Friday, 21 April. Mr E. LeQ. Herbert, *President*, was in the Chair.

The Report of the Benevolent Fund was received, and the Report of the Council, including the Statements of Account with the Auditors' Report, for the year ended 30 September, 1960, was adopted.

On the report of the Scrutineers of the ballot, the following were declared elected to the offices and in the capacities specified :—

President: Sir William Kershaw Slater, K.B.E., F.R.S.

Vice-Presidents: Mr George Dring, Dr F. A. Robinson, Mr E. J. Vaughan, C.B.E.

General Members of the Council: Professor R. M. Barrer, F.R.S., Mr G. H. Bottomley, Dr Frank Hartley, Professor E. D. Hughes, F.R.S., Dr D. G. O'Sullivan, Dr R. H. Purcell, C.B., Dr E. C. Wood.

Censors: Mr E. LeQ. Herbert, Sir Christopher Ingold, F.R.S., Sir Harry Jephcott, Dr D. W. Kent-Jones.

(A complete list of Officers and Members of Council for 1961-62 is given on p. 186.)

Dr D. I. Coomber and Dr K. G. A. Pankhurst were re-elected as Honorary Auditors, and Messrs J. Y. Finlay, Robertson and Co., Chartered Accountants, as professional auditors.

Under Special Business, a resolution was passed sanctioning an increase from £3,000 to £6,000 in the maximum sum of money that may be transferred in any period of 12 consecutive months from the general funds of the Institute to the Royal Institute of Chemistry Fund for the Development of Education in Chemistry.

A fuller account of the proceedings at the Annual General Meeting will be published next month.

MELDOLA MEDAL AWARD, 1960

The Meldola Medal for 1960 has been awarded to JOHN NEWTON BRADLEY, for his work in the field of physical chemistry, with special reference to the kinetics of reactions involving free radicals and reactions in shock waves studied by mass spectrometry.

The Meldola Medal, which is the gift of the Society of Maccabaeans, is awarded each year to the chemist who, being a British subject and under 30 years of age at 31 December in that year, shows the most promise as indicated by his or her published work. Awards are made by the Council of the Royal Institute of Chemistry, with the concurrence of the Society of Maccabaeans, on the recommendation of a specially appointed advisory committee.

J. N. BRADLEY was educated at Humbersone Foundation School, Cleethorpes, and at Birmingham University, where he was awarded First Class Honours in the B.Sc. Chemistry degree and was winner of the Frankland Prize in 1952. From 1952 to 1955 he carried out research under the supervision of Sir Harry Melville and Professor J. C. Robb on the reactions of simple alkyl radicals in the gas phase. During this period he was successively Priestley Scholar (1952-54) and University Research Scholar (1954-55). He received the Ph.D. degree in 1955 and entered the Royal Air Force in the General Duties (Pilot) Branch with the rank of Pilot Officer. He completed advanced flying training in 1957, receiving the Flying Trophy and Ground School Trophy for his course. During the remainder of his commitment, he served with No. 99 Squadron, R.A.F. Lyneham, with the rank of Flying Officer. In August, 1957, he was awarded a Commonwealth Fund Fellowship, tenable at Harvard University, and worked there with Professor G. B. Kistiakowsky until June, 1959. At this time he was appointed lecturer in inorganic and physical chemistry in the University of Liverpool.

Dr Bradley has studied the reactions of simple alkyl radicals by the molybdenum oxide diffusion technique and by mass spectrometry. In addition to establishing rate constants for various reactions, he demonstrated the dependence of the relative rates on the presence of 'hot' (energy-rich) radicals.

At Harvard University he became interested in reactions in shock waves and, with Professor Kistiakowsky, he developed a time-of-flight mass spectrometer which would analyse the gas behind the reflected shock wave whilst reaction was proceeding. He studied the kinetics of nitrous oxide decomposition and was able to observe the build-up of oxygen atoms prior to the establishment of a steady state.

This was followed by a study of the pyrolysis and oxidation of acetylene. Polymeric species were detected in both cases, although different in nature and in mode of formation. Several of the primary processes occurring were resolved by this work.

Dr Bradley has also investigated the thermal decomposition of nitroparaffins in the gas phase and some of the reactions of methylene in the liquid phase.

Current research interests include the emission from shock-heated gases, the mechanism of thermal ionization in shock waves by mass-spectrometry, the combination of flash photolysis and shock tube techniques, the latter being used for ultra-rapid flow generation, and the development of a modified 'Chemical' shock tube with improved time resolution, subsequent analysis being based on vapour phase chromatography. Both theoretical and experimental work is continuing on the reactions of free radicals at normal temperatures.

He is also the author of a volume entitled *Shock Waves in Chemistry and Physics* which will be published by Methuen and Wiley later this year.

APPOINTMENTS

United Kingdom Advisory Council on Education for Management.—The Council has nominated Professor P. D. Ritchie to represent the Institute on the Joint Committee which is to administer the Diploma in Management Studies and the Certificate in Business Administration in Scotland (*cf. J.*, 145).

British Standards Institution.—Mr B. Bann has been nominated as representative of the Institute on Tech. Comm. CIC/19, which has been set up to prepare BS specifications for certain gases of chemical interest.

Binding of Journals and L.M. & R.—Members and subscribers are reminded of the special arrangements for the binding of Journals in green buckram at the price of 19*s.* 6*d.* per annual volume, including return postage. Those making use of this service are asked to note that Volume 84 (1960) should contain the *Annual Report of the Council* for the year ended 30 September, 1960, which has been printed in the new format.

Arrangements have also been made for the binding in grey cloth of *L.M. & R.* for 1959–60 in one volume, at 11*s.* 6*d.*

All inquiries and matter for binding should be addressed to W. Heffer & Sons Ltd, Hills Road, Cambridge.

Yorkshire Council for Further Education.—A week-end course for heads of departments of chemistry and senior lecturers in technical colleges, arranged by the Yorkshire Council for Further Education, was held at Doncaster Training College on 7–9 April. Among the speakers were Mr J. Maitland-Edwards, H.M.I., staff inspector for chemistry, Dr I. J. Faulkner, works manager, Imperial Chemical Industries Ltd, Billingham Division and Professor H. M. Irving, University of Leeds. There were two discussion sessions, one on the proposed Licentiateship grade of the Institute (discussion introduced by Mr D. G. Chisman, *Education Officer*), the other on 'Multichoice Methods of Examination' (introduced by Dr R. T. Bottle, Bradford Institute of Technology). There was also a showing of new films.

Dr Newton Friend—Celebration Dinner.—A dinner has been arranged by the Committee of the Birmingham and Midlands Section, in collaboration with the Midlands Section of the Oil and Colour Chemists' Association, to celebrate the eightieth birthday of Dr J. Newton Friend. The dinner will take place on Friday, 26 May, at the Chamber of Commerce Dining Suite, Harborne Road, Birmingham, and will cost 30*s.* exclusive of wines.

Dr Friend will be remembered as a former head of the department of chemistry at the Birmingham Technical College (now the College of Advanced Technology). Some Members will be aware that Dr Friend is also the senior surviving Past President and an Honorary Member of the Oil and Colour Chemists' Association.

A fund has been established to present Dr and Mrs Friend with a suitable memento of this pleasant occasion. In accordance with Dr Friend's wish the balance of any monies contributed by Members will be donated to the Benevolent Fund as a testimonial.

Contributions to the fund and applications for tickets should be addressed forthwith to Mr S. A. Ray, British Titan Products Co. Ltd, Stratford House, Stratford Place, Camp Hill, Birmingham, 12.

PERSONAL NOTES

News of Hon. Fellow

Lord Cohen of Birkenhead has been elected president of the National Society for Clean Air. The term of office is two years.

Honours and Awards

Mr C. G. Hampson, *Fellow*, has had the Insignia Award in Technology of the City and Guilds of London Institute (paper-making) conferred upon him.

Dr A. D. Jenkins, *Fellow*, of Gillette Industries Ltd, has been awarded the degree of D.Sc. of the University of London for his work in the field of physical chemistry. The major part of his research was on the mechanism of polymerization reactions.

Dr J. D. Kendall, *Fellow*, director of the European research laboratories of the Minnesota Mining and Manufacturing Co. Ltd, has had the degree of D.Sc. of the University of London conferred on him for his work on the chemistry of photographic sensitizing dyes and heterocyclic systems.

Dr G. S. Saharia, *Fellow*, reader in chemistry, University of Delhi, has been awarded the degree of D.Sc. by the University of Aligarh. His work was concerned with the study of alicyclic systems, especially five- and six-membered rings and the mechanism of the Fries Reaction.

Sir Alexander Todd, F.R.S., *Nobel Laureate*, *Fellow*, will be admitted to the honorary degree of D.Sc. of the University of Wales at a congregation of the University to be held in Cardiff on 21 July.

Dr E. W. Ward, *Fellow*, senior lecturer in organic chemistry, Leicester College of Technology and Commerce, has had the degree of D.Sc. of the University of London conferred on him for his contributions to naphthalene chemistry and other researches.

Dr W. P. D. Wightman, *Associate*, has been made an Effective Member of the International Academy of the History of Science.

Societies and Institutions

Dr T. P. Colclough, C.B.E., *Fellow*, technical adviser, British Iron and Steel Federation, has been elected an Honorary Vice-President of the Iron and Steel Institute.

Society of Chemical Industry.—Lord Fleck of Saltcoats, K.B.E., F.R.S., *Fellow*, will remain President of the Society until the annual meeting in 1962. Dr J. Ferguson, *Fellow*, has been re-elected Hon. Treasurer; Dr H. K. Cameron, *Fellow*, Hon. Secretary for home affairs; Mr E. L. Streatfield, *Fellow*, Hon. Foreign Secretary; and Professor W. G. Overend, *Fellow*, Publications Secretary.

Educational

Mr G. Crank, *Associate*, has left Queen's University, Kingston, Ontario, to take up an appointment as senior teaching fellow in chemistry, Monash University, Melbourne.

Mr C. J. Crumpler, *Fellow*, has resigned his post of senior science master, Westminster School, to take up an appointment as H.M. Inspector of Schools.

Mr V. A. Hewlett, *Fellow*, has recently been appointed principal of the new College of Further Education at Ebbw Vale, Monmouthshire.

Mr H. T. Jobson, *Fellow*, has left Abbot Laboratories Ltd, where he was control manager, to take up the post of routine analyst, school of agriculture, King's College, Newcastle upon Tyne.

Dr Edna M. F. Roe, *Fellow*, has had the title of reader in spectroscopy in the University of London conferred on her in respect of her post at the Institute of Cancer Research, Royal Cancer Hospital.

Mr B. Shelton, *Associate*, has transferred from Queen's University, Ontario, to the department of organic chemistry, University of New South Wales.

Dr C. B. Taylor, *Fellow*, formerly senior chemistry master, Totnes Grammar School, is now senior lecturer in chemistry, City Training Centre, Sheffield.

Dr I. D. P. Wootton, *Fellow*, has had the title of reader in chemical pathology in the University of London conferred on him in respect of his post at the Postgraduate Medical School.

Public and Industrial

Mr J. R. Blanco, *Associate*, has now left the head office of the Shell Chemical Co. Ltd to take up an appointment as senior chemical engineer, Carrington Research Centre, Petrochemicals Ltd.

Mr E. J. C. Bowmaker, M.B.E., *Fellow*, has resigned from the board of Canning Town Glass Works Ltd.

Mr F. H. Braybrook, *Fellow*, director and general manager of Petrochemicals Ltd until the amalgamation with Shell Chemicals Ltd in 1960, will shortly join the management of Shell Italiana S.p.A., Genoa. For the past 18 months he has been carrying out special assignments for the director of co-ordination—chemicals, Shell International Chemical Co. Ltd.

Mr L. Brealey, *Fellow*, has been appointed deputy chief scientist, International Combustion Ltd, Derby. He was formerly with Boots Pure Drug Co. Ltd, Nottingham.

Mr W. D. Burnet, *Fellow*, a director of the Distillers Co. Ltd, has been appointed chairman of Scottish Malt Distillers Ltd.

Mr J. H. Cooper, *Associate*, has resigned his position as technical manager, John Bull Rubber Co. Ltd. He has formed a company, Agricolastic Rubber & Plastics Co. Ltd, Irton, Nr Scarborough, to trade in rubber and plastics articles especially for the agricultural industry.

Mr B. R. Corry, *Associate*, works chemist, Acheson Dispersed Pigments Co. Ltd, has been appointed production superintendent of the Dukinfield, Cheshire, works.

Mr R. Coskie, *Fellow*, has relinquished his appointment as technical manager, Beecham Overseas Ltd, to take up the position of chief production chemist, Beecham Group Ltd.

Sir Charles Dodds, M.V.O., F.R.S., *Fellow*, has been appointed chairman of the Advisory Council of Scientific Research and Technical Development.

Dr J. S. Gourlay, *Fellow*, formerly an overseas director of Imperial Chemical Industries Ltd, has been appointed a Group A director, alkali and general chemicals.

Mr N. Greenblau, *Associate*, has resigned his appointment as chief chemist, Vereeniging Consolidated Mills Ltd, to assume the technical directorship of Consulting Testing Laboratories, consultants, Cape Town, and also

an appointment as technical director of the Dry Cleaning Research Institute for Southern Africa.

Dr E. Gregory, *Fellow*, director and chief metallurgist, Edgar Allen & Co. Ltd, Sheffield, has relinquished his full-time executive position, but will remain in office as a 'non-executive' director.

Dr R. A. Gregory, *Fellow*, joint managing director of Midland Silicones Ltd, has been appointed to a new position with the parent company, Albright & Wilson Ltd, as head of the inter-company planning department.

Mr D. M. Grudgings, *Fellow*, works manager, Clitheroe Works, Imperial Chemical Industries Ltd, Billingham Division, has been appointed gas section manager, Heysham Works.

Mr L. Grunberg, *Fellow*, has been appointed superintendent of the fluids group, National Engineering Laboratory, Glasgow, with the rank of Deputy Chief Scientific Officer.

Dr J. Hargreaves, *Associate*, has been appointed refractories technologist, Derbyshire Silica Firebrick Co. Ltd.

Mr H. W. G. Hignett, *Fellow*, has been appointed a director of the International Nickel Co. (Mond) Ltd. He remains managing director of Henry Wiggin & Co. Ltd.

Mr B. A. Hills, *Associate*, formerly of the department of chemical engineering, West Ham College of Technology, is now with the Polymer Corporation (Pty) Ltd, Homebush, New South Wales.

Mr W. E. Huddart, *Associate*, has relinquished his position with Albright & Wilson (Mfg) Ltd, to take up an appointment with Hoechst Chemicals Ltd, the U.K. distributors for Farbwerke Hoechst A.G. He will be responsible for sales in North-East England and Scotland.

Mr W. Hunter, *Fellow*, has been appointed a director of British Celanese Ltd.

Mr J. O. Jones, *Fellow*, has retired from the National Agricultural Advisory Service, Ministry of Agriculture, Fisheries and Food, Wolverhampton, and is now chief technical adviser (agriculture) for the Southmead Mortar Co., Bristol.

Dr I. Kumar, *Associate*, formerly of Bareilly (U.P.), India, is now at the Third N.Y.U. Medical Research Division, Goldwater Memorial Hospital, New York. He expects to remain in the United States for about two years.

Mr F. D. L. Noakes, *Fellow*, has been appointed a director of the Ambuco Co. Ltd and of Metalion Ltd. The companies are associated with The Consolidated Gold Fields of South Africa Ltd, of which he is chief metallurgist.

Mr D. Page, *Associate*, has recently resigned his post as a scientist with the National Coal Board to take up a position as assistant technical officer, Imperial Chemical Industries Ltd, Billingham Division.

Dr A. O. Pittet, *Associate*, formerly of the department of chemistry, Ohio State University, Columbus, is now with the Natural Gum Laboratory, Stein, Hall & Co., New York.

Mr P. J. Platt, *Fellow*, formerly general works manager of Kemball, Bishop & Co. Ltd, has been appointed general works manager for the Pfizer Group of companies. He will be responsible for all production and engineering matters.

Mr C. Pugh, *Fellow*, has been appointed to the board of County Laboratories Ltd as product research director.

Dr G. S. Rao, *Associate*, formerly Assistant Professor of Chemistry, University of Saugar, India, is now a research officer, chemistry division, Atomic Energy Establishment, Trombay, Bombay.

Mr R. C. Rooney, *Associate*, has left B.I.P. (Chemicals) Ltd, and is now senior development chemist, Southern Analytical Ltd.

Mr W. Rosenberg, *Fellow*, has been promoted to process control and development manager of Morganite Resistors Ltd, Jarrow.

Dr B. J. Rushton, *Associate*, formerly of the Department of Geological Survey of Tanganyika, is now chief analyst, Magnesium Elektron Ltd.

Mr F. Savaage, *Associate*, managing director of the Anchor Chemical Co. Ltd, has been appointed chairman.

Mr D. S. Smith, *Associate*, has been appointed works manager, Ayrton, Saunders & Co. Ltd, Liverpool. He was formerly production superintendent, Genatosan Ltd.

Dr R. Thompson, *Fellow*, has been appointed manager of the research department of Borax Consolidated Ltd at Chessington. He was formerly assistant research manager.

Mr D. E. Verrier, *Associate*, formerly at Horlicks Ltd, Slough, is now with Hanworth Food Products Ltd, Colnbrook, Buckinghamshire.

Retirements

Mr F. Fancutt, C.B.E., *Fellow*, is retiring from the post of assistant director of research (chemical services), British Transport Commission, on 30 June.

Mr J. W. Kerr, *Fellow*, commercial managing director of Imperial Chemical Industries Ltd, Billingham Division, is to retire on 31 May.

Mr A. S. Nickelson, *Fellow*, retired as Group Leader of the Woolwich and Chatham outstation, Chemistry Division, A.E.R.E., Harwell, on 17 March. He has been appointed a consultant to the A.E.R.E., Harwell, as from the same date.

Mr A. T. S. Simpson, *Fellow*, retired from his position of manager, oil operations department, Shell Refining Co. Ltd, on 28 February.

Mr H. W. Vernon, *Fellow*, chemical superintendent and technical director of W. J. Bush & Co., has retired after 45 years' service with the company. He will continue to be associated with the company in a consulting capacity.

OFFICERS AND MEMBERS OF COUNCIL, 1961-62

President

Sir William Kershaw SLATER, K.B.E., D.SC., HON.D.SC., F.R.S.

Immediate Past-President, Vice-President ex officio

Ernest Le Quesne HERBERT, B.SC., F.H.-W.C., M.I.CHEM.E., F.INST.F., F.INST.PET.

Vice-Presidents

Harry Julius EMELÉUS, C.B.E., PH.D., D.SC., A.R.C.S., F.R.S.

George DRING, M.A., B.SC., M.I.CHEM.E., F.P.I.

Richard Alan MORTON, PH.D., D.SC., F.R.S.

George Rowntree RAMAGE, PH.D., D.SC., F.S.D.C.

Frank Arnold ROBINSON, M.SC.TECH., D.SC., LL.B.

Ernest James VAUGHAN, C.B.E., M.SC., A.R.C.S., D.I.C., F.I.M.

Hon. Treasurer

Harold BURTON, PH.D., D.SC.

General and District Members of Council

William Rogie ANGUS, M.A., PH.D., D.SC. : *North Wales*

Leonard BALMFORTH, B.SC. : *Sheffield, South Yorkshire and North Midlands; Hull and District*

Harry James BARBER, PH.D., D.SC.

Richard Maling BARRER, D.SC., SC.D., HON.A.R.C.S., F.R.S.

Frank BELL, PH.D., D.SC., F.R.S.E. : *Edinburgh and East of Scotland; Stirlingshire and District*

Robert William BOLLAND, B.SC., PH.D.

George Henry BOTTOMLEY, M.SC.

William BRADLEY, PH.D., D.SC.

Charles Mills CAWLEY, C.B.E., PH.D., D.SC., A.R.C.S., D.I.C., F.INST.PET., F.INST.F.

Ernest Harrison COULSON, M.SC., A.R.C.S., D.I.C.

Denis CROWLEY, M.SC., F.I.C.I. : *Dublin and District*

John Edward DAVIS, O.B.E., M.INST.GAS E., F.INST.F.

Frank Henry DAY, M.SC., PH.D. : *Cumberland and District; North Lancashire*

Reginald Langham ELLIOTT, B.SC., PH.D., F.T.I., F.S.D.C. : *Leeds Area; Huddersfield*

Percival Francis ELLIS, M.B.E., B.SC. : *South Wales; Cardiff and District*

Sidney John FLETCHER, B.SC., PH.D., D.L.C. : *Manchester and District*

Charles FORRESTER, PH.D., F.H.-W.C., A.M.I.CHEM.E., F.INST.F., F.R.S.E.

Robert Albert Ernest GALLEY, B.SC., PH.D., A.R.C.S., D.I.C. : *Overseas*

Donald Clarence GARRATT, PH.D., D.SC.

Leslie Horton Williams HALLETT, M.A., B.SC. : *Newcastle upon Tyne and North-East Coast; Tees-side*

Frank HARTLEY, B.SC., PH.D., F.P.S.

Frederick Denison Maurice HOCKING, M.SC., M.B., B.S., M.R.C.S., L.R.C.P., A.C.G.F.C., M.I.BIOL. : *Bristol and District; South-Western Counties*

Edward David HUGHES, PH.D., D.SC., F.R.S.

Louis HUNTER, PH.D., D.SC.; *East Midlands*

Frederick Cecil HYMAS, M.SC. : *London; East Anglia* (1)

Sir Christopher Kelk INGOLD, D.SC., A.R.C.S., D.I.C., F.R.S.

William Ford KIRKPATRICK, A.H.-W.C., F.I.C.I. : *Belfast and District*

Samuel Aaron MILLER, M.A., B.SC., PH.D. : *London; East Anglia* (2)

Desmond Gerard O'SULLIVAN, B.SC., PH.D., D.I.C.

Richard Eric PARKER, B.SC., PH.D. : *Mid-Southern Counties; Thames Valley*

Ronald Herbert PURCELL, C.B., B.SC., PH.D., A.R.C.S., D.I.C.

Patrick Dunbar RITCHIE, B.SC., PH.D., F.P.I., M.I.CHEM.E., F.R.S.E. : *Glasgow and West of Scotland*

Henry Norman RYDON, M.SC.TECH., PH.D., D.PHIL., D.SC., A.R.C.S., D.I.C.

Charles SIMONS, B.SC., PH.D., A.R.C.S., D.I.C., Barrister-at-Law

Ralph Louis WAIN, PH.D., D.SC., F.R.S.

Mearns Bruce WATSON, B.SC., PH.D. : *Aberdeen and North of Scotland; Dundee and District*

Percy Noel WILLIAMS, M.SC. : *Liverpool and North-Western*

Walter WILSON, PH.D., D.SC., A.R.C.S., D.I.C. : *Birmingham and Midlands*

Eric Charles WOOD, B.SC., PH.D., A.R.C.S.

David WOODCOCK, PH.D., D.SC.

Leslie YOUNG, PH.D., D.SC., A.R.C.S.

(District Members of Council are indicated by references in italics to the Local Section(s) within their Districts)

Section Activities

Aberdeen and North of Scotland

Recent Meetings. The meeting on 22 February was the Chemical Society Pedler Lecture, given by Professor R. D. Haworth, F.R.S., entitled 'Some Problems in the Chemistry of the Gallotannins'.

At the meeting on 15 March Mr D. C. Elgin and Dr J. Linton gave a talk on 'The Lurgi Pressure Gasification Process'. With the aid of printed diagrams and tables distributed to the audience, the lecturers gave a description of the Lurgi-type gasifier and its uses in providing household gas for the Scottish gas grid based on Westfield. The use of Lurgi gas as a basis for synthetic reactions was also described. The vote of thanks was proposed by Mr H. Mill.

As a change from the usual dinner the joint annual function this year took the form of an informal social evening held on 30 March in the new University Hall of Residence. A short illustrated talk on cheese was given by Mr Robinson, of the College of Agriculture, and this was followed by a 'tasting' at which guests sampled about 16 varieties of cheese. A buffet, bar and band were also provided and the occasion was most successful.

Belfast and District

Annual General Meeting. The A.G.M. of the Section was held on 27 March at Queen's University, Belfast. Professor C. Kemball was in the Chair. The following Officers and Members of Committee were elected for the year 1961–62: Chairman, Professor C. Kemball; Vice-Chairman, Dr R. J. Magee; Hon. Secretary, Mr I. W. Milligan; Hon. Treasurer, Dr S. M. Nelson; Hon. Assistant Secretary, Dr D. H. Thow; Members of Committee, Professor H. B. Henbest, Dr A. J. Howard and Messrs C. S. McDowell, M. J. Semple and W. F. Kirkpatrick (*ex officio*, Member of Council); Hon. Auditor, Dr R. C. Pink.

Birmingham and Midlands

Recent Section Meetings. Recent lectures in Birmingham have included: Professor A. W. Johnson on 'The Actinomycin Group of Antibiotics' (*see* below) and Dr P. H. Plesch on 'Comparison between Cationic and Radical Polymerizations.'

At Stoke Professor C. C. Addison spoke on 'Unusual Properties of Nitrates' and Professor F. S. Dainton on 'Principles and Possible Applications of Radiation Chemistry.' In connection with the last lecture a visit was made to the Winnington Factory of Imperial Chemical Industries Ltd, Alkali Division.

At Wolverhampton a joint meeting was held with the Wolverhampton Society of Applied Science, at which Mr F. E. T. Kingdon spoke on 'The Chemical Aspects of Fire Protection.'

On 3 March a 'Ladies' Night' was held at Birmingham, at which a Max Factor make-up demonstration was given.

It has been noticeable that the attendances at the outer centres such as Stoke, Coventry and Northampton are far better than in Birmingham.

Actinomycin Group of Antibiotics. Professor Johnson (*see* above) pointed out that actinomycin was isolated in 1941 by Waksman and Tishler and was the first important antibiotic to be obtained, preceding penicillin by about a year. The extreme toxicity of actinomycin seemed to preclude any chance of commercial exploitation, and for many years it remained a laboratory curiosity. However, the recent important demonstration that actinomycin has anti-tumour activity has revived both chemical and biological interest in the compound. The early chemical studies had revealed the nature of the five amino acids, each duplicated, in actinomycin: in actinomycin D these were L-threonine, D-valine, L-proline, sarcosine and L-*N*-methylvaline and in actinomycin C_3 D-alloisoleucine replaced D-valine. The hydroxyl group of the threonine unit is lactonized with the terminal carboxyl of L-*N*-methylvaline. The action of baryta gave a small yield of a peptide-free derivative, actinomycinol, which was eventually identified as 2,5-dihydroxy-3,6-dimethylacridone-1,4-quinone formed by a complex rearrangement of the actinomycin chromophore.

The 3-aminophenoxazone chromophore was recognized by Brockmann on the basis of an interpretation of the products of acid decomposition of actinomycin and confirmed by the synthesis of a variety of related compounds. Brockmann has recently achieved a synthesis of actinomycin C_3 itself. Many members of the actinomycin family are now recognized, and these all contain the same chromophore and differ only in the nature of the peptides. Many variants of L-proline in the peptide chains have now been recognized; active compounds are known with hydroxyproline, ketoproline, sarcosine and pipecolic acid replacing the proline. Furthermore, the two peptide chains need not be identical, and a degradative method was evolved by Bullock and Johnson to separate the chains and thus to examine each in turn. A biosynthetic method has been evolved to produce many new 'unnatural' actinomycins which are at present being evaluated both by biochemical and clinical means. The existence of other antibiotics, *e.g.* viridogrisein or etamycin, staphylomycin, echinomycin and antimycin, with an overall structure closely related to that of actinomycin, led to speculations on the mode of biogenesis of these compounds.

Annual General Meeting. The A.G.M. of the Section was held at the College of Advanced Technology, Birmingham, on 22 March. The Minutes of the

previous Annual General Meeting, the Committee's Report for 1960 and the Financial Statement for the year ending 30 September, 1960, were approved. The following were elected Officers and Members of Committee for the ensuing year: Chairman, Mr G. King, M.B.E.; Vice-Chairman, Mr S. A. Ray; Hon. Treasurer, Dr M. Williams; Hon. Secretary, Dr J. E. Gregory; Members of Committee, Professor J. C. Robb, Drs M. E. Foss, W. I. Stephen and W. Wilson (District Member of Council) and Messrs F. J. Armson, K. A. Hyde, E. G. K. Pritchett (Immediate Past Chairman), M. L. Richardson and L. H. Vaughan. Messrs A. Argyle and G. Barnett were re-elected Hon. Auditors. Dr R. J. Doyle proposed a vote of thanks to the retiring Members of Committee and Mr E. M. Joiner to the Hon. Auditors.

BRISTOL AND DISTRICT

Ladies' Night. The Section Meeting on 23 March took the novel form of a Ladies' Night sponsored by Birds Eye Ltd, at the Bristol College of Science and Technology.

The meeting opened with a talk on the origin of the industry from an astute observation by Clarence Birdseye of the remarkable preservative powers of intense cold on the more subtle qualities of foodstuffs. This is due to the rapid formation of minute intracellular ice crystals which do not crush animal or vegetable cells.

The audience then saw a film of the rigorous control exercised over a major product—green peas. Market research showed the desirable properties which led to the selection of appropriate seed. This is grown by farmers under the close supervision of buyers, the moment of harvesting being determined by a test of the physical properties of sample peas in a 'tenderometer.' Shelling, cleaning and blanching are followed by rapid cooling in shallow packages to a low temperature at which storage is continued up to the point of sale.

There is a continuous effort to increase the existing wide range of products which are readily bought by all classes of the community.

An excellent buffet supper was provided by the sponsors.

CUMBERLAND AND DISTRICT

Colour Photography. On 17 February, at the Windscale Club, Seascale, Dr E. Macdonald, of Imperial Chemical Industries Ltd, Dyestuffs Division, lectured on 'The Chemistry of Colour Photography.' He commenced by giving a brief outline of the principles on which colour photography is based. White light and all the colours of the spectrum can be obtained by mixtures of the three main primary lights, blue, green and red, colours to which the eye is sensitive. This was successfully demonstrated in 1861 by Maxwell, who accurately reproduced the colours of a tartan ribbon by projecting the three photographic separation positives through blue, green and red filters and superimposing. A modern development of this type of 'additive' process is Dufaycolor.

In 1869 Du Hauron showed that combination of yellow, magenta and cyan (blue–green) filters in the *same* beam of light ('subtractive' process) could also produce all the colours of the spectrum. Dyeing separation records with such dyes is the basis of the Technicolor process. A method of producing the required yellow, magenta and cyan dyes by the colour development of exposed layers of silver halide emulsion in the presence of colour formers was due to the work of R. Fischer in 1912, but was not utilized for about 20 years. Dr Macdonald described the manner in which this reaction and other organic chemical reactions had contributed to the present-day status of colour photography.

The make-up of modern materials, such as colour transparencies, colour negative and colour paper, and the processing involved were suitably demonstrated and supported by chemical experiments. Dr Macdonald concluded by showing typical examples of the materials now available, particularly colour prints.

EAST ANGLIA

Ion Exchange. On 16 March, at Colchester, Dr R. E. Kressman, chief research chemist of the Permutit Company Ltd, presented a film and gave a talk entitled 'An Introduction to Ion Exchange.'

The chemistry of resins based on polystyrene was described. Examples were given of the range of applications of ion-exchange resins in the laboratory and industry. One application of special interest was that of electrodialysis. The effect of the presence of traces of organic compounds in water on the poisoning of resins was mentioned.

Mr W. C. Hanson proposed the vote of thanks.

Organic Surface Coatings. A meeting was held at Stowmarket on 28 March, when Mr N. W. Thompson, of the research department, Imperial Chemical Industries Ltd, Paints Division, gave a lecture entitled 'New Organic Surface Coatings.'

The speaker outlined the development of organic surface coatings during the past 15 years. A concise account was given of the synthesis of the principal resins. The effect of the molecular weight of the polymer on viscosity and coating properties was mentioned. The lecture was followed by a lively discussion in which the speaker answered a large number of questions on topics ranging from synthetic organic chemistry to problems encountered by 'do it yourself' enthusiasts. The vote of thanks was proposed by Dr J. Williams.

EAST MIDLANDS

Paper Chromatography of Dyestuffs. On 14 February, at the Leicester College of Art and Technology, the Chemical Society of the College were the hosts at a meeting when Mr J. C. Brown, of Ciba Clayton Ltd, Manchester, spoke of his work on 'The Paper Chromatography of Dyestuffs.' Mr E. R. Pike, Vice-Chairman of the Section, was in the Chair. A report of the lecture, which was well illustrated by slide and paper chromatograms, has already been given (*see J.*, 1960, 222). The vote of thanks was proposed by Mr D. Robbins.

Annual General Meeting. The A.G.M. of the Section was held on 23 March at Derby. The following were elected Officers and Members of Committee: Chairman, Mr E. R. Pike; Vice-Chairmen, Dr R. F. Phillips and Messrs G. Oldham and L. P. Priestley; Hon. Secretary–Treasurer, Mr R. W. Hale; Hon. Recorder, Dr T. A. Elliott; Members of Committee, Professor L. Hunter, Drs W. E. Addison and E. S. Stern and Messrs C. Bostock, F. R. Mumford, N. Nix, T. J. Reeve, D. Robbins, C. W. Stone and C. S. West.

Immediately after the business meeting, members enjoyed two films entitled 'An Introduction to Ion Exchange' and 'Unseen Enemies.'

EDINBURGH AND EAST OF SCOTLAND

Annual General Meeting. The A.G.M. was held in the North British Hotel on 16 February, with Mr G. W. Walker in the Chair. The following were elected to serve on the Committee: Mr G. E. Dodds, Mr A. H. P. Doran, Dr P. McDonald, Dr T. Shedden, and Dr F. N. Woodward. Mr C. G. Cochrane was re-elected Hon. Auditor. The Chairman expressed the thanks of the Section to the retiring Committee members, and moved a special vote of thanks to Mr G. Barclay in appreciation of his services as organizer of the highly successful Christmas lectures for young people.

Some Aspects of the Chemistry of Isoquinoline Alkaloids. After the A.G.M., Dr K. W. Bentley, chief research chemist of J. F. Macfarlan & Co. Ltd, described work originating from two hypothetical structures for the red poppy alkaloid, rhoeadine, one of which was subsequently proved to be correct by Czechoslovakian workers. In a study of compounds analogous to the possible structures for rhoeadine, papaverine methosulphate was reduced to (±)-laudanosine by sodium borohydride, and the same reagent reduced papaveraldine to papaverinol and papaveraldine methosulphate to ketolaudanosine and α-hydroxylaudanosine. The hitherto unprepared ketolaudanosine was also obtained by Oppenauer oxidation of the hydroxy compound. Its methiodide was found to undergo rapid autoxidation and the intermediate hydroperoxy compound then oxidized the iodide ion, being itself reduced to an *N*-dimethyl carbinolamine which readily decomposed to a benzil derivative. The Hofmann degradation of ketolaudanosine, hydroxylaudanosine, and the diols resulting from lithium aluminium hydride reduction of narcotine and hydrastine were discussed, and the results compared with those observed during thermal decomposition of the corresponding tertiary amine oxides and the sodium–ammonia reduction of quaternary salts.

Some Problems in the Chemistry of the Gallotannins. On 21 February, Professor R. D. Haworth, F.R.S., delivered his Pedler Lecture at a meeting held jointly with the Chemical Society, the Society of Chemical Industry and the University of Edinburgh Chemical Society. The Pedler Lectureship provides an opportunity for eminent chemists to survey developments in various fields of organic chemistry, and on this occasion the tradition was most successfully upheld by Professor Haworth's stimulating account of a field of research which has progressed rapidly during the past few years.

North British Rubber Co. Ltd. On 16 March, a party of members of the Chemical Society, the Society of Chemical Industry and the Royal Institute of Chemistry was entertained by the North British Rubber Co. Ltd on a conducted tour of their Castle Mills factory, Edinburgh. For over a century this company has been

the backbone of the rubber industry in Scotland and, indeed, was amongst the pioneers of rubber in Great Britain. Its history is linked with America and it is known to be the first corporate investment of American capital in Great Britain. Shortly after the discovery of vulcanization an American, Henry Lee Norris, seized the opportunity to circumnavigate the patent laws, which did not then apply in Scotland, by setting up a rubber factory in Scotland using the process of vulcanization discovered in America. A few years later the son-in-law of the founder, then general manager, made a major break-through with the invention of the detachable pneumatic tyre. The Bartlett–Clincher

patent, as it was known, is still the basis of the pneumatic tyre of today with its beaded edge.

After touring the control testing laboratories and then the compounding section, where the raw rubber stock is mixed in huge Banbury mixers, the party next visited the new hose-making shop, opened in 1959 and said to be one of the largest of its kind in Europe, to witness the complex machinery and processes used in the manufacture of various types of rubber hose. Sizes varying from $\frac{1}{4}$ in diameter to 14 in diameter are made, the latter for use in oil-drilling operations and the discharge of oil at quayside installations. Additional processes apply an armour of wire braiding where this is required. The visitors were then conducted round the tyre-making department, where considerable interest was displayed in the various processes which go into the making of the modern motor-car tyre. Finally, after inspecting an exhibition demonstrating the wide range of products and materials made by the company, a very welcome supper was provided in the canteen. Dr F. R. Smith, on behalf of the visitors, thanked the hosts for their hospitality, and paid special tribute to those members of the staff who had planned the tour and acted as guides to make the visit such an interesting occasion.

HUDDERSFIELD

'Terylene.' A joint meeting with the Huddersfield College of Technology Chemical Society was held at the College on 22 February. Dr P. V. Youle, of Imperial Chemical Industries Ltd, Heavy Organic Chemicals Division, spoke on 'Terylene Intermediates and Polymerization.' The lecturer outlined the chemical steps in the synthesis of polyethylene terephthalate (I.C.I. Fibres Division's 'Terylene'). Terephthalic acid is produced by oxidation of *p*-xylene, and purified through the methyl ester. Dimethyl terephthalate is made to react with ethylene glycol to form 'monomer' in the ester-interchange step, and the monomer is then polymerized.

Some of the underlying research work was discussed, with emphasis on the care with which the purity of the dimethyl terephthalate has to be safeguarded, and the physical and chemical-engineering factors involved in the polymerization step. The maintenance of high standards of polymer quality was also discussed.

The lecture was followed by a lively discussion of various matters raised by the speaker during the talk. The vote of thanks was proposed by Mr F. W. Jarvis. This was the first meeting of the Section to be held in the new buildings of the College. The room used was found to be very comfortable and suitable for meetings, and the occasion gave an opportunity to see some of the excellent facilities now made available to students.

Annual General Meeting. The A.G.M. of the Section was held at Alexandra Chambers on 23 March, with Dr E. Tittensor, Chairman, presiding. The reports of the Hon. Secretary and Treasurer were adopted. It was noted that although the attendance of members at meetings had been maintained at the level of recent years, there had been a fall in the numbers of non-members attending. Dr E. Tittensor retired from office as Chairman and was re-elected as a Member of Committee. Dr R. R. Pritchard was elected as Chairman. Mr W. R. Barker retired from the office of Hon. Treasurer. Mr W. S. Mitchell and Mr F. Schofield retired from the Committee and Mr Mitchell was elected Hon. Treasurer. Dr H. H. Goldthorpe kindly agreed to serve again as Hon. Auditor. Dr Tittensor thanked the retiring members of Committee for their services and expressed the Section's appreciation of Dr Goldthorp's work as Hon. Auditor for many years.

The Annual General Meeting was followed by the showing of three films. These were: 'Photography at Work,' 'Visum Electronicum' and 'Antarctic Crossing.' Most of those present then adjourned to a local hotel where a buffet supper had been arranged. The main purpose of this was to enable new Corporate and Graduate members to meet Dr G. R. Ramage, *Vice-President*, Dr R. L. Elliott, District Member of Council, and members of the Section Committee.

HULL AND DISTRICT

Ion Exchange. Dr V. E. Gripp, of the Permutit Company Ltd, gave a lecture on 'Industrial Applications of Ion Exchange' at the University of Hull on 16 February. He was introduced by Dr T. S. Harrison, Section Chairman.

The lecture was preceded by an excellent new sound film in colour, in which the mechanism of cation and anion exchange was demonstrated and also some applications of ion exchange in industry.

Dr Gripp discussed several types of ion-exchange materials that are currently available, and reviewed the applications to which each type was more suitable. The relationship between the total exchange capacity of a resin column and the chemical loading to breakthrough was related to the regenerant applied and also to multi-column operation. Variations of the degree of polymer cross-linking, which affects moisture absorption, and bead size were described as being of particular importance in their analytical application. Various specific examples of the uses of ion-exchange resins were explained, including ones in the field of analytical chemistry, separation of rare earths and amino acids, removal of contaminants from electro-plating solutions, and the purification of sugar.

The lecture was followed by a lively discussion, and the vote of thanks was proposed by Mr E. W. Lown.

LEEDS AREA

Open Meeting. The Annual Open Meeting sponsored by the Section jointly with the Yorkshire Section of the Society of Chemical Industry was held at the University

of Leeds on 2 February. In the absence through illness of Dr Craik, Vice-President of the S.C.I., Dr Coffey, Chairman of the Manchester Section of the S.C.I., presided over a gathering of nearly three hundred members and their ladies, to whom Dr A. J. Green, C.B.E., formerly director of research for the British Ceramic Research Association, gave a fascinating account of 'Pottery Manufacture in Outline—Pioneers, Practice and Progress.'

Pottery, one of the oldest of the traditional crafts, has today expanded into an industry covering also ceramics and heavy clay, essential to the construction of all industrial furnaces, and having an output worth £200,000,000 per annum; its technology is therefore fundamental. The great Josiah Wedgwood, F.R.S., was by nature a scientist; he was a friend of Priestley, knew Scheele and corresponded with Lavoisier. His notebooks record some 7,000 experiments, and as early as 1789 he tried unsuccessfully to get his fellow potters to form a company to conduct research. The eighteenth century was an era of consolidation; the pioneer of the modern age of ceramics was J. W. Mellor, and the application of science to the industry was signalized by the formation of the North Staffordshire (now the British) Ceramics Society, which publishes some 40 papers a year.

The lecture was followed by an excellent film illustrating modern methods of pottery manufacture in all its stages; during the preceding reception members and guests were able to inspect an exhibition of the industry's artistic products.

Dr D. McNeil paid tribute to Dr Green as one of the world's leading ceramists and an authority on what might be regarded as inorganic polymers, and expressed the thanks of the audience for the interesting way in which he had traced the development of a traditional craft into an industry firmly based on scientific knowledge. Mr C. L. Evans thanked the Houldsworth School of Applied Science and members of the industry for their help in organizing the display of exhibits.

Tropical Agriculture. The meeting of the Section held at the University of Leeds on 22 February, under the chairmanship of Dr McNeil, was a notable occasion, for Professor R. L. Wain, F.R.S., of Wye College, gave us an inspiring lecture on 'Some Chemical Aspects of Tropical Agriculture.'

Taking examples from his own experiences in East and West Africa, the Sudan, Rhodesia and the West Indies, Professor Wain indicated the importance of chemical research in increasing the levels of food production in the tropics. In many parts of the world today we find hunger, malnutrition and starvation, yet the world population is rapidly increasing and at the same time, with advances in medical and chemical sciences, people are living longer. All these factors stress the vital importance of increasing the world's food supplies. If the agricultural knowledge we already possess could be properly applied in the 'developing' countries, there would be enormous increases in world food, for a very large proportion of that now produced comes from small peasant holdings where hand labour, over-cropping, over-stocking and high losses from pests and diseases can be expected. However, Professor Wain emphasized that, in order to achieve increases in food production on the scale which will be required in the future, it would be necessary to bring the basic sciences to the services of agriculture on an ever-increasing scale. The chemist has a vital role to play in this development, in helping to solve problems related to the soil, the plant and the animal and in the control of pests, diseases and weeds.

Consideration was given to a number of specific problems which the lecturer thought could only be solved by fundamental research work, and an account was also given of some of the educational and research institutions which are now doing such important work in oversea territories.

The appeal of the lecture was greatly enhanced by a profusion of coloured slides taken on visits overseas.

Dr W. Cule Davies proposed the vote of thanks to Professor Wain and said that in answering the challenge of the problems of tropical countries he had thrown down a challenge of his own which would give chemists food for much serious thought.

LIVERPOOL AND NORTH-WESTERN

Chemical Structure of Proteins. On 2 February, at the University of Liverpool, Professor H. D. Springall gave a lecture on 'Some Aspects of the Chemical Structure of Proteins.' Mr E. Myer was in the Chair.

Professor Springall briefly classified proteins as globular or fibrous, and went on to outline the difficulties encountered in isolating a protein in a homogeneous condition. The difficulties had been surmounted by working at low temperatures in aqueous media with a restricted number of techniques, and many globular proteins have been obtained in a crystalline condition.

He proceeded to discuss methods for determining the molecular weight, size and shape of a globular protein. Since an elementary analysis of a protein is of little value (β-lactoglobulin, for example, gives $C_{1734\pm89}\ldots$), protein analysis is most conveniently described in terms of amino-acid composition; the lecturer discussed the methods of amino-acid analysis and of amino-acid sequence determination, which he illustrated by reference to work on insulin and evolidine.

He then considered the problem of protein synthesis, and indicated the methods available for the stepwise and polymerization synthesis of peptides. Professor Springall concluded his lecture by discussing the conformations of structural elements (helical and 'coiled coil') in proteins, as revealed especially by X-ray studies.

The vote of thanks was proposed by Mr B. Haynes.

LONDON

Film Show. A joint meeting with the College Chemical Society was held at South-West Essex Technical College on 1 February. The audience was welcomed by Mr R. D. Longstaff, and the Chairman was Mr A. J. Turnbull. The films shown were: 'My Goodness,' 'Hard Metal' and 'Van Meergeren's Faked Vermeers.'

The Chairman thanked the College authorities for the facilities provided.

Organic Reactions in Strong Alkalis. A meeting was held at Sir John Cass Technical College on 7 February. Mr P. A. Raine was in the Chair and introduced the speaker, Professor B. C. L. Weedon. The lecturer first described a number of model studies on the alkali fusion of fatty acids and their derivatives. He showed that the Varrentrapp reaction, in which an ethylenic acid is converted into a saturated acid with two fewer carbon atoms, acetic acid and hydrogen, can be rationalized in terms of a prototropic migration of the double bond and a subsequent fission of the retro-aldol type. He then illustrated the extension of the reaction to more highly unsaturated acids and acetylenic acids.

The lecturer discussed next the reactions of alcohols and ketones under strongly alkaline conditions. Primary alcohols were dehydrogenated to the corresponding carboxylic acids. Secondary alcohols gave the corresponding ketones which then underwent a number of reactions, the most important being a hydrolytic fission to give acids and hydrocarbons. The reactions of α-glycols involved a dehydrogenation and a subsequent rearrangement of the benzylic acid type. The mechanism of these reactions was discussed, and Professor Weedon showed that a rational explanation could now be given for the industrially important alkaline fission of ricinoleic acid.

Finally, the lecturer showed that the information derived from these model studies could be used to interpret much of the extensive literature on the alkali fusion of other classes of natural products. By way of illustration he cited examples from the degradation of sterols, alkaloids, pyrones and many related heterocyclic compounds.

Reaction Mechanisms. A meeting of the Section was held at the North-West Kent College of Technology, Dartford, on 13 February. Dr T. Dewing, Chairman of the Kent Sub-Section, introduced the speaker.

Professor E. D. Hughes opened his lecture by stressing the general nature of organic reactions and discussing the conditions favouring homolytic and heterolytic bond fission. The mechanism of electrophilic addition to the ethylenic bond was outlined and contrasted with nucleophilic addition to the carbonyl group. Catalysed nucleophilic addition reactions were considered, and the nature and scope of processes of the aldol type and Michael addition were compared and contrasted.

The lecturer then dealt with the application of kinetics to problems in organic chemistry. The S_N1 and S_N2 substitution reactions were outlined and compared with the corresponding E1 and E2 elimination reactions, and problems such as stereospecific behaviour, competing reactions, inversion of configuration and racemization were fully discussed. A notable feature was the correlation of reactions which differed superficially; for example, the mechanism of the keto–enol conversion was compared with a typical E2 elimination.

Professor Hughes also dealt with the mechanism of aromatic substitution, and he stressed the similarity of electrophilic attack on ethylenic and benzenoid systems. Particular stress was laid on the participation of the nitronium cation in nitration, the halogen cation in halogenation and the alkyl cation in the Friedel–Crafts reaction. Abnormalities in the latter reaction were discussed, and rearrangements of the n-propyl and n-butyl groups during the Friedel–Crafts reaction were compared with the rearrangement of the neopentyl group in aliphatic substitution.

Professor Hughes concluded by emphasizing that a great many organic reactions were capable of interpretation in the light of two fundamental mechanisms.

A lively discussion followed, a striking feature being the vigorous participation of student members. The vote of thanks was proposed by Mr F. L. Hulbert.

The Public Analyst and His Work. Mr T. McLachlan was the lecturer at a meeting held at the Norwood Technical College on 14 February.

The Principal, Mr H. V. Hillman, welcomed the Institute members. Mr Raine then took the Chair and referred to Mr McLachlan's services to the profession and in particular to the Section.

Mr McLachlan began on an historical note and suggested that the King's Winetaster was a forerunner of the public analyst. The function of the public analyst has evolved from the necessity for developing civilizations to provide adequate pure food supplies, and the public conscience was being steadily awakened during the eighteenth and nineteenth centuries against the growing evil of exploitation and adulteration of food. Various texts and vivid illustrations from some of the classic books of the early nineteenth century on adulteration were shown on slides.

The first Act for prevention of adulteration of food and drink was passed in 1860. It stressed the necessity for greater vigilance on the part of local authorities and provided for appointment of public analysts, but did not make such appointments compulsory.

At one time milk was one of the most adulterated foods, and the lecturer took the dairy industry to illustrate with slides the improvement of hygiene in food production. In general the percentage of adulterated food samples fell consistently until the beginning of the last war.

He gave specific examples of food adulteration and described some of the difficulties of the public analyst when called upon to act as expert witness.

Public analysts are recognized under various Acts of Parliament (for example Food and Drugs, Pharmacy and Poisons) and foreign governments usually accept the certificate of a British public analyst. There is a tendency for the Ministry of Health to take over bacteriological work, but the lecturer considered that microbiology is still an essential part of the analyst's training.

The Government has constituted a Foods Standard Committee of the Ministry of Agriculture, Fisheries and Food, although the lecturer suggested that its terms do not fulfil all the requirements of a much earlier Court of Reference of 1896.

A very comprehensive exhibition of modern apparatus used in analytical work had been arranged by Mr Fill, head of the chemistry department of the College, and staff from the United Dairies Ltd demonstrated milk analyses.

During the course of the lively discussion Mr McLachlan referred to the gradual decrease in the number of public analysts, primarily because of the large capital required to provide the apparatus necessary for modern techniques.

The vote of thanks was proposed by Mr Stevens.

Advances in Inorganic Chemistry. On 15 February, at University College, Dr J. S. Anderson, F.R.S., lectured on 'Some Recent Advances in Inorganic Chemistry.'

Dr Anderson selected for discussion the structure and reactions of inorganic solids. All solids are imperfect and the study of their defects helps in understanding solid-state chemistry. In an ionic solid, one ion may be replaced by another of similar size; if the valency is different there must be compensation—*e.g.* a vacant lattice position—so that electrical neutrality is maintained. If the ion is of the same element, non-stoichiometric compositions result, though the range of composition is usually rather narrow except at high temperatures. An example of this behaviour is ferrous oxide, which is always slightly deficient in iron.

At high temperatures formulae such as CoS and CoS_2 are only limiting compositions. CoTe has the NiAs structure; continued abstraction of metal atoms from between the sheets of telluriums gives complete transition to $CoTe_2$, with the CdI_2 layer structure. At lower temperatures the vacant sites may assume ordered arrangements, and separate phases, often of large unit cell size and apparently complicated formula, result. Thus the newly recognized intermediate oxides of cerium, praseodymium and terbium are all derived from a $Ce_{32}O_{64}$ unit cell structure with varying numbers of vacancies at oxygen sites, *e.g.* Pr_6O_{11} is really $Pr_{32}O_{58}$ or $Pr_{32}O_{59}$ with five or six vacant sites.

Complex intermediate phases may also appear through the way co-ordination numbers are maintained. In WO_3, an octahedron of oxygen atoms surrounds each tungsten atom, the WO_6 octahedra sharing corners. As the oxide is reduced, groups of octahedra economize in oxygen by sharing edges in an ordered manner; a whole series of oxides W_nO_{3n-1} is obtained.

The lead oxide system is of interest in that whereas reduction of PbO_2 results in a complete change of structure, successively forming $Pb_{12}O_{17}$ and $Pb_{12}O_{19}$, oxidation of PbO takes place by random insertion of oxygen atoms in the structure forming a (metastable) non-stoichiometric oxide $PbO_{1\cdot4-1\cdot5}$.

The vote of thanks was proposed by Dr Hall.

Chemical Problems of Space Flight. The Section meeting on 7 March was held at the College of Technology, Hatfield, under the Chairmanship of Mr Raine. Mr D. Hurden, research manager of the de Havilland Engine Co. Ltd, presented a paper on 'Some Chemical Problems of Space Flight.'

The lecturer began by defining the three difficulties of interplanetary travel. One had, firstly, to escape from the earth's gravitational field; secondly, to travel, maybe for months, through airless space; and, finally, on arrival at one's destination, to live in what was likely to be an alien environment. For such a journey, one's vehicle must be some kind of rocket, the size of which depends mainly on two factors. These are the mass ratio of the fuel-laden to the fuel-unladen rocket and the velocity of the jet. The first factor is primarily an engineering problem, and is concerned with the design of the structure and with using methods which will keep the overall weight down. In the second factor, the jet velocity, the chemist comes into his own. The jet velocity depends on a suitable choice of chemical reactants. For example, a glance at the periodic table and the use of a standard calculation reveal that the best possible liquid propellent that could be used is a mixture of liquid hydrogen and fluorine. In view of the latter's properties it is not to be wondered that other systems of propulsion are now being investigated. In any case, theoretical considerations suggest other methods may be more efficient. Thus, higher jet velocities can be achieved by passing suitable gases through the hot core of a nuclear reactor, although development of this idea is restricted by weight considerations. Another possible future development is to utilize the recombination of free radicals.

In the journey through space, a most difficult chemical problem is the provision of a suitable atmosphere within the rocket. Carbon dioxide must be kept to a minimum and sufficient oxygen must be available. Some 20 methods have been proposed, ranging from absorption of all carbon dioxide and the provision of oxygen from a liquid source to the use of green algae. It seems, however, that no one method can be regarded as unquestionably the best.

Mr Hurden concluded his lecture by describing the

probable atmosphere of other planets in the solar system and considering the possibility of life upon them. In his final remarks he underlined the particular importance of chemistry in the training of engineers of the future. The vote of thanks was proposed by Dr R. F. Robbins.

Gas Chromatography. On 2 March, Dr A. T. James, of the National Institute for Medical Research, London, gave a lecture on 'Recent Developments in Gas–Liquid Chromatography' at the Medway College of Technology. Dr Dewing was in the Chair.

After a brief introduction giving the basis of gas–liquid chromatographic separations, Dr James described several recent developments that have led to greater sensitivity and wider application of the technique. He described the hydrogen-flame ionization detector and the family of argon ionization detectors, emphasizing their relative sensitivities and their different applications. These highly sensitive detectors have permitted the use of smaller amounts of sample and smaller amounts of stationary phase. He described ways of introducing these samples and then gave examples of the resolutions that are now possible. In certain applications the analysis time is so short that the ordinary potentiometric recorder is too slow in response. Traces can, however, be satisfactorily obtained on an oscilloscope.

He also described how an unknown compound may be identified by its relative retention volume on two or more different stationary phases. This can be further enhanced by the use of radioactive isotopes, and a simple device was described by which the amount of radioactivity could be measured, thus allowing specific activities to be readily determined.

After discussion, the vote of thanks was proposed by Mr Miall and the meeting concluded after Dr Dewing had thanked the College authorities for the facilities afforded to the Section.

Public Lecture. The second Public Lecture was held at Hendon Technical College under the Chairmanship of Mr Raine on 29 March, when Dr K. G. A. Pankhurst gave a talk on 'The Story of Soap and the Growth of Modern Synthetic Detergents.'

The vote of thanks was proposed by Mr F. C. Hymas.

Visit to the Stock Exchange. On 5 April, a party of 40 members and guests visited the public gallery of the Stock Exchange. After the film 'My Word is My Bond' had been shown, a guide gave a short explanation of the working of the Stock Exchange, so that they could better understand what would otherwise appear a chaotic scene. Members were then able to stay in the gallery to watch the dealings in stocks and shares.

Outside in Throgmorton Street a placard asked: 'Have Gilts reached the bottom?'. Though the party did not know the answer, they had learned much about a great institution.

MANCHESTER AND DISTRICT

Polymers that are Different. On 14 February at the College of Further Education, Stockport, Professor R. N. Haszeldine gave a lecture on some of the newer aspects of polymer chemistry. First of all he classified polymers according to their 'backbone' of chains of atoms. The largest group is the one with an organic backbone of carbon atoms. Another group has a semi-organic backbone of carbon atoms joined to another element such as oxygen, *e.g.* C–O–C–O–C–. A further class has a completely inorganic backbone such as the polymers based on silicon chains. These materials were described during the course of the lecture with specific references to those that extend the fields in which polymers find application.

The reactions of α-olefins undergoing polymerization were considered in some detail (*a*) from the aspect of formation of syndiotactic or isotactic polymer units during free radical polymerization, and (*b*) from the aspect of anionic polymerization to give stereoregular polymers.

The structural features that need to be introduced into a polymer in order to give improved thermal or chemical stability were next considered, and particular attention was paid to polymers from cyclo-oxabutanes (*e.g.* Penton), formaldehyde (*e.g.* Delrin), nitroso-compounds and esters.

Dr Fairbairn proposed the vote of thanks.

The Analyst in the Chemical Industry. Mr H. E. Stagg spoke on this subject at a meeting held at the Technical College, Bury, on 23 February. In his opening remarks he emphasized that, unlike our American and Canadian colleagues, we have no natural resources to live upon, and the only means of maintaining our high standard of living is to sell to the world the products of our skill and inventiveness. To do this our products must be either novel or competitive in price and quality. The analytical chemist has an important part to play in achieving these ends. The function of the analyst in the chemical manufacturing industry can be divided into three parts: research, analytical control and product service. To illustrate the function of the analyst in research, Mr Stagg used the manufacture of the dyestuff Amaranth as an example. He outlined the synthesis and showed that other substances are also produced. The presence of these by-products is a disadvantage in that they reduce the yield of Amaranth, and also some of these by-products are medically dangerous and therefore reduce the usefulness of the product. The techniques of absorptiometry and chromatography enable the analyst to study the effect of varying the conditions of manufacture, and thus discover those leading to the highest yield of the purified product.

Once the process has been established, it is the function of the analytical control group to maintain

the product specification. This is to be achieved with the minimum of analytical on-cost and the analytical chemist has developed many effective measuring instruments for this purpose. For example, the acidities of reactions are frequently controlled by potentiometers actuated by electrodes immersed in the reacting liquids. Similarly, colour reactions can be controlled by photoelectric detectors. The most recent development in the science of instrument control is the Perkin Elmer autoanalyser, which takes a sample of the liquid or gas and separates the components by gas chromatography. The instrument selects a particular peak on the chromatograph and converts the area of this peak into a pneumatic signal, which in turn actuates the valves that control the plant system. Strict control of many substances is necessary because of their medical hazards. For example, cancer of the bladder can be caused by ingestion of minute amounts of β-naphthylamine. Most hydrocarbon or chlorinated hydrocarbon solvents are metabolic poisons, and aromatic amines are notorious for interfering with the haemoglobin cycle. The lung and respiratory tissues can be damaged by alcohols, aldehydes and isocyanates.

The technical service departments deal in the main with two classes of problem, customers' complaints and the examination of competitors' products. Complaints may be genuine, frivolous or plainly dishonest. A company with a good reputation to uphold is frequently regarded by the more shady operator as a source of easy money, and these people are not averse to obtaining an *ex gratia* payment if this will be made to keep them quiet. The investigation of competitors' products is an important function of the analyst. The need for this arises partly from a natural desire to see what others are doing and partly from the need to protect infringement of patent rights. The samples are usually complicated artifacts and frequently contain polymers and surfactants. Great skill and experience are needed for this kind of analysis, which is among the most difficult that are required.

Since about 1925, when the classical techniques of gravimetric and volumetric analysis were the order of the day, the analytical chemist has been continuously developing more effective methods, particularly in the form of specialized instruments. The potentiometer became the standard method of acidity measurements, and the single-beam photoelectric absorptiometer replaced the unreliable human eye. The balanced-beam Spekker achieved stability and independence of light-source fluctuation. The arc-emission spectrograph became the most elegant method of determining minute amounts of metals, and though not used quantitatively so much nowadays it still remains a powerful tool. The far-off mutterings of Oxford took tangible form with the marketing of the first infra-red spectrometers. It was during the late 1930s that the new term chromatography began to be heard with increasing frequency among analytical chemists. In particular, rapid advances were made in dyestuffs research with this technique, and in 1952 another and even more powerful technique burst upon the world. Vapour-phase chromatography has proved to be the most versatile analytical weapon so far introduced. We can separate and measure the components of any mixture which will boil without decomposition up to 250°C. It is surprising how many organic materials fall directly into this category or can be made to do so by some simple chemical modification. Even more tools are being developed, such as the mass spectrograph and the neutron-activator. Such new discoveries combine to make the task of the analyst more exciting, exacting and rewarding.

The lecture was followed by a very lively discussion that showed considerable interest in the subject, and the lecturer was thanked by Mr D. G. Grosse, head of the chemistry department.

Modern Plastics. At Rochdale on 14 March Mr R. W. Hall, of the Research and Development Laboratories, British Resin Products Ltd, gave a lecture on 'Modern Plastics—Their Properties and Uses.' The classification of plastics materials into thermosetting resins and thermoplastics was described. The output of the plastics industry has risen exponentially over the last few years, and this was compared with the output of a traditional industry such as steel, the output of which had risen slowly over the same period. Polythene and polyvinyl chloride are two materials which are widely used, and the dependence of their properties on their molecular weight and method of preparation was discussed. Finally the applications of other plastics, and in particular some of the newer ones such as Delrin, were reviewed. The extensive range of plastic articles which Mr Hall showed as examples gave added interest to the subject.

Mr Taylor proposed the vote of thanks to the lecturer.

Left to Right: Dr P. Crofts, Miss J. Ridgway, Mr and Mrs H. Kaye, Dr L. R. Ridgway and Mrs Crofts (next column)

Annual Dinner. The Annual Dinner of the Section was held in the Bavarian Suite at Belle Vue on 17 March. The large attendance was a reflection of the increased interest in the activities of the Institute in the area. Unfortunately, Professor R. N. Haszeldine was unable to be present but his place was taken by the past Chairman, Dr L. R. Ridgway. After an excellent meal Dr Ridgway made the only address of the evening by welcoming the guests, Mr and Mrs H. Kaye, of the Institute of Petroleum, and Dr and Mrs P. Crofts, representing the Chemical Society. The dinner was followed by dancing, which was made most enjoyable by the well-selected programme and the variety of the spot prize events. We are indebted to Mr Husbands and Mr Heslop for their work in organizing this occasion.

MID-SOUTHERN COUNTIES

Polysaccharides of the Human Body. On 13 March a meeting was held jointly with the Portsmouth and District Chemical Society and the Portsmouth Pharmaceutical Society, at the Portsmouth College of Technology. Dr A. B. Foster gave a lecture entitled 'Some Polysaccharides of the Human Body.'

As the topic is so broad, the lecturer confined his remarks to hyaluronic acid, chondroitin sulphate and heparin. First, the chemistry of uronic acid and the amino sugars was outlined. The polysaccharides were dealt with by their location and function in the human body, and next by their structure, particularly their breakdown by enzymes, and then by their synthesis. The synthesis of hyaluronic acid was discussed at some length, especially with relation to the mechanism forming the alternating chain of uronic acid and amino sugars; this gave rise to a description of the fascinating enzymic build-up of these molecules.

The structure of chondroitin sulphate was complicated by the sulphate groups but classical methods gave results that have been justified by work on the infra-red spectra. Heparin also contains sulphur in another type of group, $-NH-SO_3H$, complicating the structure even more, but through modern methods, especially labelled groups, this structure is being elucidated.

The lecture was well illustrated by slides and after questions the vote of thanks was proposed by Dr I. Campbell.

SHEFFIELD, SOUTH YORKSHIRE AND NORTH MIDLANDS

Ladies' Evening. The annual Ladies' Evening meeting was held at the University of Sheffield on 27 February. Miss West, of Max Factor Ltd, gave a talk on the application of cosmetics, with demonstrations on members of the audience. The vote of thanks was proposed by Mrs G. Robinson, and Dr A. S. C. Lawrence was in the Chair. After the meeting light refreshments were served in the University.

The Work of the Chemistry Department. A meeting was held at the University of Sheffield on 15 March at which Professor R. D. Haworth, F.R.S., gave a short introductory talk on the work of the chemistry department to an audience which included a number of local scholarship-year students. The departmental work includes the teaching of chemistry not only to students taking general and honours degrees in the subject, but also to metallurgists, chemical engineers and so on. The new department was opened in October, 1953, when, of the 2,000 students at the University, some 500 were taking chemistry. Further extensions have now been opened and these figures have increased to 3,000 and 750 respectively, but by 1965 the present accommodation will be inadequate since the numbers are expected to increase to 5,000 and 1,250. The number of students at present engaged on research is about 70 and this will reach 120 by 1965. The topics of research include: in organic, tannins, steroids, lipoids, free radicals and reaction mechanisms; in physical, spectroscopy, flash photolysis, fluorescence and colloids; and in inorganic, co-ordination compounds, analytical methods and X-ray crystallography.

After the introduction, the audience separated into groups and were taken on a tour of the department by various research students to see and discuss topics of interest. The Chairman for this meeting was Dr Lawrence.

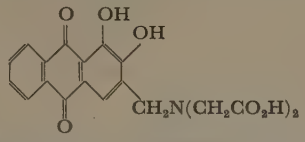
Annual Public Lecture. The annual public lecture of the Section was given on 27 March by Professor C. E. H. Bawn, F.R.S., on 'Plastics and Fibres.' A capacity audience, drawn mainly from the senior forms of grammar schools within a radius of 20 miles of Sheffield, enjoyed a most interesting lecture, illustrated by slides and demonstrations. The Chair was taken by Dr Lawrence.

TEES-SIDE

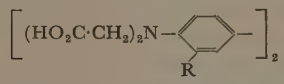
Developments in Analytical Chemistry. On 15 February, at Billingham-on-Tees, Professor R. Belcher addressed a joint meeting with local members of the Chemical Society and the Society of Chemical Industry on 'Some Developments in Analytical Chemistry.'

Professor Belcher confined his lecture to recent work into wet methods of analysis. In 1924 Knopp discovered that diphenylamine could be used as a redox indicator for ferrous to ferric titrations. The reversible change between diphenyl benzidine and diphenyl benzidine violet was later found to be the reaction responsible for the indicator colour change. More recently diphenyl benzidine has been used as an indicator for the ferrous to ferric reaction to advantage. The lecturer discussed the use of Ferroin, *N*-phenyl anthranilic acid and the new redox indicator triphenyl methyl arsonium chloride. This latter compound is especially useful in coloured solutions.

The lecturer considered that ethylene diamine tetra-acetic acid was still the best reagent in complexometric titrations. Its use had, however, been limited by the shortage of good redox indicators. Alizarin complexan



could be synthesized from alizarin by the Mannich reaction. This could be used for fluoride determinations when treated with cerous salts. Compounds of the type



were of particular use as fluorescent indicators for copper titrations where the colour of the solution was otherwise troublesome.

Sodium tetraphenyl boron had been used recently to precipitate potassium, rubidium and caesium. By preparing sodium triphenyl boron cyanide, a reagent for precipitating caesium only was obtained. New reagents have now been found in gravimetric analysis superior to cupferron and nitron.

Dr Faulkner proposed the vote of thanks.

Food Supplies. On 28 February, at Norton-on-Tees, Mr T. McLachlan addressed a meeting on 'Progress and its Effect on Our Food Supplies.'

Mr McLachlan described how food had been preserved from the earliest times by drying, usually in the sun, and by fermentation. The storage of meat in chimneys led to the development of smoking as a means of preservation. In this low-temperature smoking technique formaldehyde and phenols acted as the preserving agents. Now higher temperatures are used in smoking. Preserving agents are also used, such as diphenyl urea and propionic acid.

The methods used to make bread have again advanced through the ages. These developments, until relatively recently, were mainly concerned with methods of making flour. Now vitamin B, nicotinic acid and other materials are added to flour for a variety of reasons.

Recent methods of preserving foods include canning, bottling and all aspects of refrigeration. This latter method was originally used to allow meat to be transported, and it dates back to 1877. Now it has a range of uses, from the fishing industry to quick-freezing of fresh vegetables.

The trend of packing food in plastic wrappings was one of the more recent advances, and should make possible a higher hygienic standard.

The vote of thanks was proposed by Dr Faulkner.

Steelmaking Reactions. On 14 March, at Middlesbrough, Professor F. D. Richardson addressed a joint meeting with local members of the Chemical Society and the Society of Chemical Industry on 'The Chemistry and Rates of Steelmaking Reactions.'

Professor Richardson said that in the past study of the physical chemistry of the steelmaking process had been mainly confined to equilibria in the reacting phases. He described how the kinetics of homogeneous reactions could be applied to steelmaking reactions. In particular he considered the reaction involving the breakdown of silica to give silicon and two oxygen atoms, and iron oxide to give iron and an oxygen atom at the metal–slag interface. In the case of the breakdown of silica, a rate constant was obtained which was of the same order as that observed, showing that the reaction might be chemically controlled. However, for the iron oxide breakdown a calculated rate of a completely different order to that observed was found, and it was concluded that the reaction was controlled by transfer. By considering the slag–metal interface the transfer from one phase to the other can be calculated. The rate of steelmaking was considered in terms of agitation being provided by bubbles rising from fissures in the firebrick base, and the recently adopted technique of blowing with oxygen.

Dr D. G. Jones thanked the lecturer on behalf of the audience.

THAMES VALLEY

Prospects for Research Chemists. A combined meeting of the Alembic Club and the Section was held in the Inorganic Chemistry Lecture Theatre, Oxford, on 13 February, with Dr M. L. Tomlinson, President of the Alembic Club, in the Chair. Before proceeding to the main business of the meeting, Dr Tomlinson proposed, and Sir Cyril Hinshelwood seconded, a motion that the Alembic Club send a telegram to Dr T. S. Moore on 19 February, on the occasion of his 80th birthday; the proposal was carried.

Mr Sidney Barratt, of Albright & Wilson Ltd, then discussed the career prospects of research chemists, with frequent reference to the long history of his Company. His general theme was that several years spent in a research laboratory gave a sound and first-class training for eventual directorship in any company dealing with chemicals or chemical products.

Unfortunately, owing to ill-health, the second speaker, Sir Owen Wansbrough-Jones, was unable to attend the meeting, and the time set aside for this talk was devoted to questions and a general discussion of Mr Barratt's theme. A vote of thanks to the speaker was moved by Sir Cyril Hinshelwood.

Saturated Electrophilic Substitution. On 23 February a joint meeting of the Section with local members of the Chemical Society was held at the University of Reading, with Professor E. A. Guggenheim in the Chair. Professor Sir Christopher Ingold gave an interesting

lecture on 'Saturated Electrophilic Substitution.' The vote of thanks was proposed by Dr F. M. Brewer, Section Chairman.

Papers by Section Members. On 9 March, at the University of Reading, the Section held a meeting, under the Chairmanship of Dr Brewer, which was devoted to papers by younger members of the Institute, that is, those under 30 years of age. This has become a well-established and popular event, in which young members present accounts of their own research work for discussion by a mature audience with a wide range of interests; the Section has found this to be a most successful and profitable item of the programme. This year proved to be no exception.

The first paper, 'The Significance of Phase-Transition Effects in High-Polymer Systems,' by I. D. Aitken and R. Sheldon, was presented by Mr Sheldon, who began by outlining the major differences between first- and second-order phase transitions. In the latter, the fact that a discontinuity in the temperature coefficient of their fundamental thermodynamic functions provides several reasonable methods for detecting the transition temperature. The methods employed have shown the transitions to be markedly frequency-dependent, and this has caused some doubt to be expressed regarding their significance. The authors have shown that, in an amorphous polymer system, electron-irradiation-induced free radicals are stable at temperatures below the observed second-order transition temperature, but rapidly disappear above this point. One concludes, therefore, that the segmental main-chain rotation effects which are said to occur above the transition point are real in terms of the increased molecular mobility which leads to radical recombination. Finally, the authors suggest that the current widespread use of the heat-distortion point as a criterion of polymeric materials used in engineering structures should be treated with caution, as considerable changes in mechanical and electrical properties occur at the second-order transition temperature, which may be some 20–30° below the heat-distortion temperature.

The next paper, by Dr G. C. Barrett, described the efforts of various workers during the last nine years towards the synthesis of the tetracyline antibiotics. The syntheses of aureomycin (I), Terramycin (II), and tetracyline (III) have recently been reported by American groups and by German workers. The routes involved are examples of the inspired application of classical organic chemical methods, and the various approaches were discussed.

The application of the constant-current technique to the study of the formation of complex ions in molten-salt mixtures was described by Dr D. Inman in his paper on 'The Electrochemistry of Molten Salts.' A constant-current pulse was passed through a cell consisting of a small hanging mercury-drop cathode and a large silver anode, the latter remaining unpolarized, immersed in a solution of $Cd(NO_3)_2$ + various concentrations of KCl, KBr and KI in $NaNO_3$–KNO_3 solution (1 mole : 1 mole) at 263°C. From the resulting cathode potential – time relations the 'quarter-time potentials' (analogous to the half-wave potentials of polarography) which are a function of the added complexing ion (Cl^-, Br^-, I^-) concentration were determined. An analysis of these led to the formation constants of the series of complexes formed in each case. Deviations from ideal behaviour due to complex formation increased from the cadmium ion + chloride ion to bromide ion and iodide ion. The concentrations of the various complex ions as functions of complexing ion concentration were determined. The only complexes significant in the chloride and bromide cases were the CdX^+, CdX_2 and CdX_3^- species (X = Cl^- or Br^-). With the iodide the CdI_4^{2-} species was also formed, and this accounts for the much larger deviation from ideality. The advantage of the method over polarography and the applications of electrochemical studies in molten salts were succinctly discussed.

In a final paper, the applications of the method of X-ray fluorescence analysis were described by Mr R. Jenkins, who pointed out that the method depends fundamentally on the measurement of the wave-lengths and intensities of secondary radiations produced by the bombardment of an element with primary X-radiation. Elements in the range Na (11) to Np (93), have been determined, the limits of detectability being from the p.p.m. range to 100 per cent. At Esso Research Ltd, the author had successfully applied the method to the elemental analyses of completely unknown materials, for routine control analysis and also as an aid to X-ray diffraction analysis. Techniques employed include external standard addition, direct comparison with synthetic blends and the use of coherent and incoherent scattered primary radiation as internal standards. The method is particularly suited to the non-destructive examination of very small quantities of material and to the investigation of surface films and deposits. Recent developments include multi-channel quantometers for rapid batch-type analyses, and curved crystal spectrographs for the trace analysis of minute specimens. Present trends in equipment design show no immediate possibility of extending the method to the analysis of elements below atomic number 11.

The meeting was very well supported and there was a very lively and fruitful discussion.

Annual General Meeting. The A.G.M. was held on 21 March at the University of Reading. Two items of general interest, namely Section activities and the proposed new grade of membership of the Institute, were discussed. After the normal business of the meeting, the Chairman, Dr Brewer, outlined the next session's programme for comment and discussion. The

outcome of this session appeared to be that the Committee had made a correct estimate of the type and presentation of items in the programme required by the Section.

In the second half of the meeting, Mr D. G. Chisman, *Education Officer*, outlined the history of suggestions for a new grade of membership and also a register of technicians. He pointed out that the new grade of membership had wide support from many quarters. Another speaker, Mr E. J. Vaughan, described the plight of those with H.N.C. acting in the professional field, but not qualified, in both private and nationalized industries. Unfortunately, for various personal reasons, only 15–20 per cent aspire to higher qualifications. The requirements for the Licentiateship grade were then reviewed. Dr G. R. Ramage spoke of the Licenciateship as a technological qualification. All three speakers summarized the various discussions published in the *Journal* and this gave rise to a very lively discussion. Those who spoke against the suggested Licentiateship were chiefly concerned about the possibility of lowering standards and the 'back-door entrance' to Graduateship and Associate membership, but the majority of the audience appeared to be satisfied with the assurances of the 'panel' that the Institute had not the slightest intention of relaxing standards in any way.

CEYLON

Stabilization of Cobalt and Rhodium. At the first meeting of the current session held on 9 February in the new air-conditioned auditorium of the Ceylon Institute for Scientific and Industrial Research, members of the Section, together with members of the Chemical Society of Ceylon, listened to a talk on 'The Stabilization of Low Valency States of Cobalt and Rhodium.' The speaker was Dr W. R. MacWhinnie, lecturer in inorganic chemistry at the Aquinas University College, Colombo. Dr MacWhinnie discussed the successful use of 2,2′-dipyridyl in the stabilization of the unipositive oxidation state of cobalt and rhodium. He then detailed the preparation of the complexes bis-2,2′-dipyridyl cobalt(I) perchlorate, and 2,2′-dipyridyl silver(I) perchlorate, and explained how X-ray powder photographs and other evidence had revealed that the two ligands were arranged tetrahedrally about the central cation. Dr MacWhinnie said that polarographic studies and preparative studies of solutions and suspensions of 2,2′-dipyridyl cobalt(II) perchlorate containing an excess of 2,2′-dipyridyl indicated that reduction under alkaline conditions always yielded the bis-cobalt(I) complex. But similar reduction of neutral solutions yielded mixtures of the bis-cobalt(I) and of tris-cobalt(I) perchlorates. Of the rhodium complex bis-2,2′-dipyridyl rhodium(I) perchlorate, Dr MacWhinnie said that the cation was tetragonal in solution and this was confirmed by spectral studies. He concluded by indicating how low-valency-state complexes do in some respects show behaviour expected of a metal 2,2′-dipyridyl complex.

Mr N. Jayatunge, Chairman of the Section, who presided, proposed the vote of thanks.

Biochemistry of Vitamins. On 8 March, at a joint meeting with the Chemical Society of Ceylon, presided over by the President of that Society, Dr G. Ponnamperuma, Dr G. S. Wijesinha, head of the department of biochemistry at the Medical Research Institute, Colombo, spoke on 'The Biochemistry of the Vitamins.' Dr Wijesinha said that many vitamins were parts of coenzymes common to autotrophes and heterotrophes. Since such vitamins varied from one heterotrophe to another they indicated a loss of synthetic power in the heterotrophes. The vitamin common to all was the coenzyme, which, he explained, could therefore be regarded as the biochemical vitamin. Dr Wijesinha then illustrated certain aspects of the biochemical role of coenzymes.

Dr Ponnamperuma proposed the vote of thanks from the Chair.

Some Aspects of Radiochemistry. On 22 March another meeting was held jointly with the Chemical Society of Ceylon, in the Chemistry Lecture Theatre of the University of Ceylon, Colombo. Dr F. H. Kendall, of Sir John Cass College, London, and the International Atomic Agency, now in Colombo as an adviser in connection with the establishment of a radiochemical laboratory, spoke on 'Some Aspects of Radiochemistry.' Dr Kendall began by defining some of the terms used in radiochemistry such as 'isotope,' 'nuclide' and so on, and then went on to explain that radioactivity could be regarded as the manifestation of the tendency of a nuclide having an unstable arrangement of neutrons and protons in its nucleus to attain a more stable arrangement. He very briefly outlined the mechanisms involved in the emission of β- and γ-radiation, and positrons, by substances undergoing radioactive decay. Dr Kendall next discussed the uses to which radioactive isotopes had been put. He cited examples from a wide field, including the elucidation of the mechanisms of organic reactions, determination of the chemical equivalence of atoms, the study of metal–metal diffusion processes, exchange processes, trace-element analyses and analysis by natural radioactivity. He then dwelt on the radioisotopic methods of analysis, particularly with respect to dating archaeological specimens. Dr Kendall then obligingly countered the many questions asked by members of the audience with informative and logical answers. Mr Jayatunge, who presided, proposed the vote of thanks.

DECCAN

Annual General Meeting. At the A.G.M. of the Section, held at the Indian Institute of Science, Bangalore, on

30 January, the following were elected Officers and Members of Committee for 1961 : Chairman, Dr B. H. Iyer; Vice-Chairmen, Dr T. L. Rama Char and Professor P. S. Sarma; Hon. Treasurer, Dr J. V. Bhat; Hon. Secretary, Dr S. C. Pillai; Members of Committee, Drs S. C. Balasubramanian, J. Ganguly, R. K. Maller and D. Sreenivasan, and Messrs G. D. Hazra, C. P. Natarajan, M. Rajagopalan and D. G. Range Gowda.

East Africa

Sixth Annual Conference. Exactly half the total membership of the Section had registered for the Sixth Conference, held at Nairobi on 12–14 January, a very creditable effort when it is realized that the Section covers an area of about half-a-million square miles. These members and their wives were greeted by the Chairman, Mr W. H. Dyson, and Mrs Dyson at a reception given on Thursday evening, 12 January, by African Explosives and Chemical Industries.

The following morning saw the official opening of the Conference by the Kenya Minister for Commerce and Industry, The Hon. Dr J. G. Kiano, at the laboratories of the East African Industrial Research Organization. Dr Kiano stressed the importance of developing industry in Kenya, which was still largely an agricultural country and very dependent on imports for its progress.

In 1959 imports of medicinal products amounted to over £2 million, of essential oils and toilet preparations to £1¾ million, inorganic chemicals to £3½ million, organic chemicals to £2¾ million and fertilizers to nearly £1 million. While consumption of these chemical products would rise, it was important to produce more locally and so to reduce imports. In this connection many more local people would need to be trained at all levels in chemistry, and the co-operation of professional bodies such as the Institute was of the greatest importance to the Governments of East Africa.

The Chairman of the Section, Mr W. H. Dyson, expressed the thanks of the Section to Dr Kiano both for sparing the time to be present at the opening of this conference and also for a very stimulating speech. He then took the opportunity to congratulate two Fellows of the Section, Dr M. G. Edwards, who had been appointed Director of the East African Organization for Industrial Research, and Dr R. F. Naylor, Hon. Secretary of the Section, who was to be the first Professor of Chemistry at the Royal College. In his speech, Mr Dyson dealt with two of the evils facing the world today, over-population and over-organization.

The world population is being added to at a rate equivalent to the whole population of Kenya every two months. The chemist, by producing new drugs, was reducing the death rate as fast as he was helping to produce more food by fertilizers and pesticides. He could hardly be said therefore to be solving the problem of over-population. Perhaps, in common with other professional men, he could help to eradicate some of the evils of over-organization if he was prepared to come down from his ivory tower and play his full part in the complex of problems confronting us.

The first scientific lecture was by Dr T. A. Koenig, who gave an illustrated talk on 'Cement Manufacture.'

The lecturer started with a short review of the history of cement, and after giving definitions and indications of the various raw materials employed in the industry, explained the calculations necessary to arrive at the desired raw mix—taking into consideration the specifications laid down in British Standards and the formulas for the most important final cement compounds (Bogue Figures). Next, he described the various stages of production from quarry to finished cement by means of a flowsheet. The three main types of cement kilns were mentioned, and details given of the rotary kiln in use at Athi River and the processes taking place during the passage of the material through the kiln.

He went on to mention the properties of cement as laid down in the BSS, the methods prescribed for their determination and the influence of the final cement compounds on these properties. He then referred to the different kinds of cements with their various chemical compositions, and finally to the heat balance during burning. All these points were illustrated by slides. The lecture ended with the showing of the layout of the Athi River Plant.

Members paid a visit to the Athi River factory of the East African Portland Cement Company, which is situated some 20 miles from Nairobi on the open plains near the Game Reserve. The factory manufactures 270 tons of cement daily in a rotating kiln from locally produced materials. The choice of site, however, was determined by the presence of a good artesian water supply; the Athi River water is used only by wild animals. As they returned to Nairobi members saw lions in the Game Park. In the evening a visit was paid to the Donovan Maule Theatre to see a performance of 'A Lady Mislaid.'

. Saturday morning began with a session on 'The Training of Assistant Chemists,' which was opened by Mr J. W. Gailer, of Kampala, on behalf of the Committee. He referred briefly to the historical background of the present proposals, which originated at the 1958 Conference and had been steadily pursued since through the medium of sub-committees. It was now established, he said, that some 40 chemical 'technicians' were required for Uganda and 80 for Kenya over the next few years, and this had led the Committee with some confidence to put the proposals before the meeting.

In essence, Mr Gailer said the present scheme was of a 'National Certificate' type at ordinary level and

was intended to be a basis for later specialization at the Higher National level in agricultural, industrial and analytical chemistry—the main fields of interest in East Africa at present. He went on to describe the events which dictated the formulation of Overseas Ordinary and Higher (National) Certificates in engineering by the City and Guilds of London Institute since the United Kingdom National Certificate schemes could not be exported, and expressed the hope that the City and Guilds, in conjunction with the Institute, would produce a similar scheme for overseas work in the case of chemistry.

The proposed Ordinary Certificate Scheme involved three years part-time or two years full-time study, Mr Gailer said, and provision was made for those who had decided on their specialism by the inclusion of agricultural science and additional physics as endorsement subjects. Provision was also made for the broadening of the curriculum in the case of full-time or sandwich studies in a number of directions involving, for example, laboratory skills on the one hand and social studies on the other, whilst all courses would include the teaching of English.

The speaker went on to say that the most economic method of operating the course was to offer it on an inter-territorial basis at one of the technical institutes. He concluded by saying that if the meeting supported the Committee's proposals the next step in his view would be to draw the attention of the Ministries of Education in the four territories to the need for training of this kind, and to the proposals which had been formulated as a basis for meeting the need. If the Ministries were agreeable both to the need and to the method of meeting it, the Section could also offer to ask the Institute to take up the matter with the City and Guilds Institute.

After considerable discussion, the resolution 'that there is in our view the need for immediate provision of a National Certificate type of scheme of training for chemical technicians on an inter-territorial basis in East Africa, and, that we urge the Governments to make suitable provision' was unanimously passed, and the Committee was requested to forward it to the Permanent Secretaries of the Ministries of Education, together with supporting documents and explanations.

Mr A. E. Wootton, of the East African Industrial Research Organization, then addressed the conference on 'Coffee Processing with Special Reference to Off-flavours.' After a brief description of the processing carried out at the normal Kenya estate, the 'fermentation' of Arabica coffee was discussed. The changes in acid content had been followed with silicic acid column chromatography. Gradient elution of an 8 g column with chloroform – tertiary butanol solvents had been found capable of separating butyric, propionic, acetic, formic and lactic acids rapidly and accurately. A close correlation had been observed between the occurrence of propionic acid in 'fermentation' and 'onion-flavour' in the final liquor, a taint causing the industry considerable concern. The conditions favouring propionic acid production had been elucidated; changes recommended to coffee planters had met with success so far. Mr Wootton outlined the work initiated at the Industrial Research Organization to discover adequate methods of measuring poly- and mono-galacturonic acids and protopectin in order to follow the essential reaction of 'fermentation.' It was hoped that the most suitable conditions for 'fermentation' would be discovered, not only promoting the rapid breakdown of the coffee bean mucilage, but avoiding the risk of off-flavours.

The last scientific session was a lecture by Mr D. Bradwell on 'Chemical Aspects of Crime Investigation.'

Chemistry, in conjunction with many other branches of science, can make important contributions to the detection and investigation of crime, although the intelligent police officer is still the back-bone of any investigation. Identifications of body fluids are frequently required; the benzidine, haemin hydrochloride and Takayama reactions are used for blood, while seminal fluid can be detected by tests for acid phosphatase. The examination of counterfeit money, 'gold' bricks of brass and unusual injections such as 20 per cent sulphuric acid or condensed milk provides interesting chemical findings. Examination of paint flakes in breaking cases or vehicle accidents also assists the police officer.

The largest field for the chemist is undoubtedly toxicology, complicated by the multiplicity of toxic materials available to the public, and sometimes by inadequate information about the pre- and post-mortem findings. Drunken driving is engaging the attention of almost every country, and the importance of chemical determinations of blood and urine alcohol levels is in general appreciated by the Courts. Carbon monoxide poisoning appears to be losing favour with suicides as a means of chemical despatch, and most cases appear to be accidental, either through inadequate ventilation or defective appliances, such as car exhausts. Barbiturates are now manufactured and consumed in massive quantities, and the examination of viscera from deaths suspected to be due to them exercises to the full the techniques and ingenuity of the forensic chemist. Ultra-violet spectroscopy, chromatography, X-ray diffraction and infra-red absorption are all used in the estimation and identification of these drugs.

In the afternoon, members paid a visit to the laboratories of the East African Agriculture and Forestry Research Organization at Muguga, where after conducting an interesting tour, the director, Dr E. W. Russell, kindly provided tea.

The Conference finished as usual with a dinner, held this year at the Norfolk Hotel. An ingenious menu,

decorated with a pestle and mortar, offered the diners such delicacies as Lob stearate, Methyl orange pudding and Fuming mercaptan cheese; the wines were guaranteed to be of extra-low flash point. The guests of honour on this occasion were the Hon. Dr J. G. Kiano, Minister for Commerce and Industry, and Dr J. M. Hyslop, Principal of the Royal College, Nairobi. The dinner was a very enjoyable ending to a most successful conference.

EASTERN INDIA

Communications in Industry. Dr I. J. Faulkner, works manager of the Ammonia Works of Imperial Chemical Industries Ltd, Billingham Division, and Chairman of the Tees-side Section, gave a lecture on 'Communications in Industry' to the Section at the Bose Institute, Calcutta, on a recent business visit to India. The lecturer pointed out that the whole of civilization had depended on effective means of communication. It was in fact this particular property of communication which distinguished man from the lower orders. He defined communication as action of one sort or another designed to evoke a discriminating response. Such action need not be confined to the written or spoken word. There are three main types of communication: spoken with mime in the presence of the other party is the most effective; spoken without mime, as over the telephone, comes next, because there is at any rate some receiver reaction; written communication is the most difficult as it is without receiver reaction and suffers from the disadvantage that combinations of words may mean different things to different people in different circumstances. The lecturer drew particular attention to the fact that these difficulties are real enough in a country where all speak ostensibly the same language. In a multi-lingual country like India, the problem is one which requires considerable thought and merits serious attention.

Dr Faulkner went on to describe the various types of formal communication in use in industry in the United Kingdom. These range in the spoken field from informal conversations to formal meetings with published minutes. In written communication they range from the simple type of notice and wall newspaper, through house journals to such sophisticated publications as works newspapers and glossy magazines.

Finally, he drew attention to the importance of simplicity in both speech and writing. The majority of downward communication originates from educated and well-trained individuals who often fail to realize that their language is unsuited to those who have to read and understand. He put in a plea for much simpler written matter, readily understood by the employee, who would then be much more ready to give his co-operation.

The meeting ended with the vote of thanks to Dr Faulkner proposed by Dr A. B. Sen Gupta.

News and Notes

EXHIBITIONS AND COURSES

Art in Roman Britain.—An Exhibition of Art in Roman Britain, to mark the Jubilee of the Society for the Promotion of Roman Studies, will be held at the Goldsmiths' Hall, Foster Lane, London, E.C.2, on 27 June–22 July. All the works to be shown, made in Britain and abroad, were discovered in Britain, and belong to the first four centuries of our era. There will be a large and varied collection of sculpture, painted plaster, table-ware in bronze and silver, fine glass-ware, pottery and numerous smaller objects. This wide range is illustrated by the silver tray from Corbridge lent by His Grace the Duke of Northumberland; the brass helmets from Newstead lent by the National Museum of Antiquities of Scotland; the gilt-bronze head of Sulis Minerva lent by the City of Bath; and the Mithraic sculpture lent by the City of London. A complete photographic record of the Exhibition, with a general introduction and notes by Professor J. M. C. Toynbee, will be published by the Phaidon Press early in 1962.

Bradford Institute of Technology.—A special short course on 'Methods of Polymer Characterization and Analysis' will be held in the Department of Chemical Technology on 23–24 June. The course fee is £2 5*s*. There will be several lectures and periods for questions and discussion. Application forms may be obtained by writing to The Registrar, Institute of Technology, Bradford, 7.

A one-year postgraduate course in High Polymer Chemistry will begin on 2 October. It is designed for graduates in chemistry or those with equivalent qualifications, and is primarily intended for those entering or already engaged in research or production in those industries connected with plastics, synthetic fibres, surface coatings and rubber. The tuition fee for the course is £26. Application forms and further particulars may be obtained from the Registrar as above.

Health Physics.—A Summer School in Health Physics (Radiation Protection), arranged by Dr H. D. Evans, will be held in the Department of Chemical Engineering and Chemical Technology, Imperial College, on 3–14 July. The course is designed to provide basic information on principles, but will include detailed lectures on certain topics which are essential to an understanding of the subject. It is suitable for graduates in science or medicine, and should be of interest to radiation protection officers, medical officers of health, factory inspectors and others. The fee is 25 guineas. Applications for admission should be made to the Registrar, Imperial College, South Kensington, London, S.W.7, from whom further information may be obtained.

MEETINGS AND CONFERENCES

British Association Annual Meeting.—The Annual Meeting of the British Association for the Advancement of Science will be held in Norwich from 30 August to 6 September. The main scientific programme, which is arranged in 15 Sections representing the many different branches of modern science, will follow the Inaugural Address by the President of the Association, Sir Wilfrid Le Gros Clark, F.R.S. The sectional programmes will include addresses by the Section Presidents (including Professor R. G. W. Norrish, F.R.S., *Fellow*, for Chemistry, and Sir William Slater, F.R.S., *President*, for Agriculture) and the Kelvin, Darwin and Lister Lectures—inaugurated in 1958 with the object of encouraging younger scientists to explain in non-specialist language to intelligent laymen the significance of their work. There will be two evening discourses, a special young people's programme, scientific filmshows, exhibitions, demonstrations and excursions. The meeting is open to all who are interested in the progress of science and in its impact, through its application, on society as a whole. Preliminary programmes are available from the offices of the Association, 18 Adam Street, Adelphi, London, W.C.2.

Chemical Society Symposia.—Three symposia are being arranged in conjunction with the Anniversary Meetings of the Chemical Society to be held in Sheffield on 3–5 April, 1962: organic, 'Some Aspects of the Chemistry of Natural Phenols'; inorganic, 'Reactivity and Structure in Inorganic Chemistry'; and physical, 'The Transition State.' The papers given at the organic and inorganic discussions will not be published in full, but abstracts will be available to those who register for the meeting. The physical symposium will be published by the Society, and full preprints of the contributions will be available before the meeting. Full details of these Symposia and of the Anniversary Meetings will be available in December on application to the General Secretary, The Chemical Society, Burlington House, London, W.1.

Insecticide and Fungicide Conference.—The First British Insecticide and Fungicide Conference, organized by the Association of British Manufacturers of Agricultural Chemicals, will take place at the Grand Hotel, Brighton, on 6–9 November. All inquiries should be addressed to the Conference Secretary, Mr W. A. Williams, M.B.E., Cecil Chambers, 86 Strand, London, W.C.2.

International Society for Fat Research.—The Sixth Congress of the International Society for Fat Research will be held in London on 9–13 April, 1962; it will be the first time the Congress has been held in England. It is being organized under the auspices of the Society of Chemical Industry. The Congress Secretariat is at the headquarters of the S.C.I., 14 Belgrave Square, London, S.W.1.

Radio Spectroscopy of Solids.—The Institute of Physics and the Physical Society and the British Radio Spectroscopy Group are jointly holding a Conference on the Radio Spectroscopy of Solids at the University College of North Wales, Bangor, on 21–22 September. The Guthrie Lecture will be presented during the Conference by Dr D. Shoenberg, F.R.S., who will speak on 'The de Haas—van Alphen Effect and the Electronic Structure of Metals.' Programmes and application forms will be available in mid-July from the Administration Assistant, The Institute of Physics and the Physical Society, 47 Belgrave Square, London, S.W.1.

Royal Institution.—The Christmas Lectures 1961–62 will be given by Sir Lawrence Bragg, O.B.E., M.C., on 'Electricity'. There will be six lectures, on 28 and 30 December and 2, 4, 6 and 9 January, all at 3 p.m., at the Royal Institution, 21 Albemarle Street, London, W.1. Subscriptions payable by non-members of the Royal Institution are: children (10–17) £1; adults £2.

S.C.I. Summer Tour of Norway.—The Food Group of the Society of Chemical Industry is arranging for a party of members to tour Norway from 3 to 10 June. The tour will be based on Stavanger. All inquiries should be addressed to A. H. Woollen, Leonard Hill Ltd, Leonard Hill House, Eden Street, London, N.W.1.

Spectroscopic Studies.—The Applied Spectroscopy Group and Manchester and District Branch of the Institute of Physics and the Physical Society are holding a meeting on 'Spectroscopic Studies Using Time Resolution Techniques' on 16 June at Manchester. Registration is necessary, and detailed programmes and application forms are available from the Administration Assistant of the Institute and Society, 47 Belgrave Square, London, S.W.1.

Third Congress of Chemical Engineering.—A symposium on 'The Physics and Chemistry of High Pressures' is to be held at Olympia on 26–28 June as part of the Third Congress of the European Federation of Chemical Engineering (21–28 June). The symposium will mark the retirement of Professor D. M. Newitt, F.R.S., from the Courtauld Chair of Chemical Engineering at Imperial College. Suggestions for papers for inclusion in the symposium are invited. Title or subject and summary should be sent to the General Secretary, S.C.I., 14 Belgrave Square, London, S.W.1, or to Professor J. S. Rowlinson, Imperial College, London, S.W.7, as soon as possible.

University of Hong Kong.—The Golden Jubilee Congress of the University of Hong Kong will be held

at the University on 11–16 September. There will be six symposia—on muscle receptors; phytochemistry; design of high buildings; land use and mineral deposits in South-East Asia; historical, archaeological and linguistic studies on Southern China, South-East Asia and the Hong Kong region; and economic and social problems of the Far East. The Congress banquet will be held on 15 September. Further details may be obtained from the General Secretary, Jubilee Congress, University of Hong Kong.

RECENT PUBLICATIONS

Inco-Mond Magazine.—The latest issue, No. 17, is a larger and very attractive version of this well-known journal. The new layout has been adopted to provide a more comprehensive coverage of the part nickel plays in industry, commerce and research. The journal is obtainable free on request to the Publicity Department, The International Nickel Co. (Mond) Ltd, Thames House, Millbank, London, S.W.1.

Metabolic Pathways.—A chart designed by Dr D. E. Nicholson, of the School of Medicine, University of Leeds, has been published by L. Light & Co. Ltd, Poyle Colnbrook, Buckinghamshire. It is an attempt to provide a ready reference map to the more important aspects of metabolism. By the use of colour, differentiation has been made between carbohydrate, amino acid, lipid, purine and pyrimidine and co-enzyme metabolism. The incorporation of them all on the same map has stressed their essential inter-relationships and the general integration of biochemistry. Three four-colour editions are available: 30 × 40 in, varnished, linen-backed paper with metal-edged top and bottom (10*s.* each); 30 × 40 in, paper, intended for teaching purposes and wall display (7*s.*); and a 10 × 15 in reduction, primarily intended for students' personal use (75*s.* per 100, 600*s.* per 1,000).

Co-operation among Metallurgical Societies.—The Councils of the Iron and Steel Institute, the Institute of Metals and the Institution of Metallurgists have recently decided to set up a permanent Joint Consultative Committee, which will meet regularly and advise on all activities and questions of common interest.

The three Councils are convinced that every qualified metallurgist should be a Member both of the professional institution and of his appropriate scientific and technical institute. With this in view, the Council of the Institution of Metallurgists has altered the standard subscriptions payable by Members, Enrolled Graduates and Enrolled Students of the Institution resident in the United Kingdom, who will automatically have the right to apply for Membership of one of the two Institutes without liability for the payment of a further Membership subscription to that Institute.

Development and Future of Physics.—'The Development and the Future of Physics' was the theme of the first Presidential Address to the recently amalgamated Institute of Physics and the Physical Society given by the President, Sir John Cockcroft, O.M., F.R.S., on 2 May.

He made a rapid survey of recent and likely developments in solid-state physics, mentioning transistors, tunnel diodes, semiconductors, optical masers, modern electronic valves and artificial diamonds. Atomic energy development has provided another major demand for physicists, and their work ranges from determining nuclear data to the prediction of kinetic behaviour of reactors and the study of radiation damage.

Sir John thought it remarkable how the advent of rockets, with their prestige and military implications, had brought the once greatly neglected field of astronomy into the limelight. He stressed the importance of international co-operation in providing the expensive equipment now needed for fundamental research in physics.

Reconstitution of the Colour Group.—During the past year it was decided to reconstitute the Colour Group as a body separate from the Institute of Physics and the Physical Society. This is now to be effected by establishing the Group as a limited liability company, and the approval of the Board of Trade is being sought.

In preparation for this, the whole Committee of the Colour Group retired at the A.G.M. on 19 April, and a new Committee was elected to serve for one year only: Chairman, Dr R. W. G. Hunt; Vice-Chairman, Mr G. J. Chamberlin; Hon. Secretary, Mr F. J. B. Wall; and Hon. Treasurer, Dr R. A. Weale.

Members of the R.I.C. may join the Group at special rates. Applications should be addressed to F. J. B. Wall, Esq., Ramsden Colour Laboratory, Ilford Ltd, Woodman Road, Brentwood, Essex.

Scientists for Antarctic Expeditions.—The I.C.S.U. Special Committee on Antarctic Research (SCAR) now maintains a register of scientists wishing to work on Antarctic expeditions of other nations. SCAR is merely acting as a centre which may put suitable scientists from other countries in touch with national committees who could use their services to advantage. Further arrangements for the employment of individuals are then a matter of negotiation between the expedition organization and the person concerned. Men with previous polar experience would be most suitable. Registration forms are available from the Assistant Secretary, The Royal Society, Burlington House, London, W.1.

Waverley Gold Medal.—The Waverley Gold Medal Essay Competition, sponsored by *Research*, is being organized for the ninth year in succession. The first prize will be the Medal and £100, awarded for the best

essay of about 3,000 words describing a new project or practical development in pure or applied science. There will be a second prize and a special prize for a competitor under 30 years of age, each of £50. Further details may be obtained from the Editor, *Research*, 88 Kingsway, London, W.C.2. The last date for entries is 31 July.

News from I.C.I.—The Board of Imperial Chemical Industries Ltd has decided to spend more than £6 million on modernizing a large section of its Billingham factory during the next two years. Light oil is to be used instead of coke as a raw material in the production of hydrogen, which is the first stage in the manufacture of ammonia and other products of the Billingham Division. The new plant is expected to come into use in 1963.

A plant capable of distilling about one million tons of crude oil annually is to be built on a site on the North bank of the River Tees. Agreement has been reached with Shell-Mex & B.P. Ltd whereby they will make available to I.C.I. the crude oil for processing. The Heavy Organic Chemicals Division of I.C.I., which has not previously handled crude oil, will be responsible for building and operating the distillation plant, which is due for completion before the end of 1962. The naphtha produced will provide a proportion of the feedstock requirements for the Division's olefin plants at Wilton, whilst other products will be marketed by Shell-Mex & B.P. Ltd.

The same Division is to construct a maleic anhydride plant at the Wilton works. A new process will be used in which butene is oxidized with air, and the plant will have a capacity of about 10,000 tons of maleic anhydride per annum when fully developed. The construction of the plant is a further step in the utilization as chemical raw material of the butenes obtained from the Division's olefin plants at Wilton.

Visitors to the U.K.—Among those who are expected to visit this country shortly are: M. Freund, Professor of Chemical Engineering, Budapest (19–24 May); H. Neurath, Professor of Biochemistry, University of Washington (28 May–3 June); B. Borgström, department of physiological chemistry, University of Lund (29 May–3 June); P. Desnuelle, Professor of Biochemistry, Fats and Oils, University of Aix—Marseille (29 May–3 June); L. E. Hokin and Mabel Hokin, department of physiological chemistry, University of Wisconsin (28 May–3 June); J. E. Jorpes, Professor of Medical Chemistry, and V. Mutt, both of the Royal Caroline Medico-Surgical Institute, Stockholm (29 May–3 June); B. Levenberg, department of biological chemistry, Ann Arbor Medical School (7–15 June); M. Frankel, Professor of Organic Chemistry, Hebrew University, Jerusalem (11–25 June); and J. Marmur, department of biochemistry, Brandeis University (18–25 June).

CORRESPONDENCE

Productivity in Practical Organic Chemistry

Sir,—The hardboard rig suggested for the assembly of semi-micro organic apparatus (*J.*, 45) appears to be provided with an alarming number of Terry clips, all of which are attached in fixed positions on specially-cut wooden blocks. I have encountered and made similar support boards, and I much prefer a wholly more flexible arrangement. This may be achieved, at about the same cost, by using a piece of pegboard (kept flat by bolting a piece of $\frac{1}{2}$ in by $\frac{1}{2}$ in aluminium angle strip along its length) supported at each side by direct attachment, using a boss, to a retort stand. Alternatively, the pegboard could be attached to a reagent rack. Specially-designed display clips of various sizes (obtainable from The Woolston Book Co. Ltd, P.O. Box No. 17, Gamble Street, Nottingham) fit anywhere into the pegboard and give that certain freedom of movement required by assembled pieces of apparatus. 'A rather complex arrangement such as distillation under reduced pressure' can be safely supported by only three display clips.

The pegboard and aluminium angle strip are cut to the required size by the suppliers. The services of the workshop are only required to drill three suitably spaced holes in the aluminium support and to bolt the latter, employing aluminium alloy nuts and bolts, along the middle of the pegboard.

The apparatus required for any particular operation is set up by referring to diagrams of the various assemblages displayed in the laboratory.

P. D. Arculus

Solihull School,
Warwickshire

Organometallic Compounds

Sir,—While we were delighted to see your review of our publication *Organometallic Compounds* in the March *Journal* (*J.*, 119), in fairness to ourselves we should like to point out that your reviewer overlooked an entry reference to a Russian Journal. A number of Russian journals received during November were examined for the Prepublication Issue, but by chance only this one reference was found.

Your readers will be interested to learn that the publication of a subject index is definitely planned for the end of the year. Experience in the use of abstract periodicals in industry has suggested that the author index is not really worth the time and money spent on it, though we are ready to consider the views of subscribers on this matter.

R. H. Chandler

Translation and Technical Information Services,
32 Manaton Road,
London, S.E.15

OBITUARY

David George Allen. *B.* 31.7.22. *Ed.* Tiffin Boys' School, Kingston; Birkbeck College, London, 1940–44. B.Sc. He joined Mr A. P. Davison, Public Analyst, as an assistant chemist and three years later became his chief assistant. In 1956 he succeeded to the practice and retained it for the remainder of his life. (*A.* 1945, *F.* 1949). *D.* 17.1.61.

Ernest George Balls. *B.* 15.11.1887. *Ed.* St John's College, Battersea; Battersea Polytechnic, 1907–14. B.Sc., Ph.D. (Lond.). He was engaged in teaching until 1914, when he joined H.M. Forces, was wounded on active service and awarded the Military Cross in 1918. The following year he left this country to take up a post at Kamloops, British Columbia, Canada, and returned in 1921 on his appointment as science teacher at Latymer School, Edmonton, London. Later he became science master at Acton County School, a post which he held until his retirement. (*A.* 1919). *D.* 4.2.61.

Hubert Thomas Stanley Britton. *B.* 22.4.1892. *Ed.* Merchant Venturers' Technical College, Bristol; University of Bristol, 1911–14. D.Sc. (Lond. and Brist.). After a short period as a schoolmaster at Sexey's School, Bruton, he spent four years (1916–20) as a chemist in the Aeronautical Inspection Directorate (Air Ministry). He then went to King's College, London, as an assistant lecturer. After a year (1927–28) lecturing at Norwood Technical College, he joined the staff of University College, Exeter (as it was then) and seven years later was appointed to the chair of chemistry and director of the Washington Singer Laboratories. He was in office during the transition from university college to university, and had much to do with the framing of new degree regulations and other matters relating to the University's new status. He was the author of *Hydrogen Ions; their determination and importance in Pure and Industrial Chemistry*; *Conductometric Analysis*; *Chemistry, Life and Civilisation*; and many papers on physical and inorganic chemistry in chemical journals. He was a prime mover in the establishment of the South-Western Counties Sections of the Institute and of the Society of Chemical Industry. He was a member of the Council of the S.C.I. (*A.* 1919, *F.* 1922; Council 1950–53). *D.* 30.12.60.

John Richard Cracknell. *B.* 30.6.27. *Ed.* Brasenose College, Oxford, 1948–52. M.A. (Oxon). He was appointed technical officer at Imperial Chemical Industries Ltd, Plastics Division, in 1952. Two years later he became a technical service chemist at Shell Chemicals Ltd, and in 1956 he was appointed assistant, chemical industry administration, Shell Petroleum Co. Ltd. In 1958 he went to Delft as a development chemist/engineer in plastics at the Koninklijke/Shell Plastics Laboratory and in 1960 returned to this country as sales chemist/technologist in plastics with the Shell International Chemical Co. Ltd. (*A.* 1952). *D.* 30.1.61.

Rufus Gaunt. *B.* 13.4.1881. *Ed.* Yorkshire College (now University of Leeds) 1899–1902; University of Berlin, 1903–06. M.Sc. (Leeds), Ph.D. (Berlin). He became a research worker at the University of Leeds in 1906, and thereafter was successively lecturer in agricultural chemistry, University of North Wales, Bangor, 1907; research assistant, Imperial Institute, London, 1907; research assistant, University of Sheffield, 1911. He joined H.M. Forces in 1914 and two years later was transferred to the Chemical Warfare Department. On his release in 1919, he became a research assistant at the University of Leeds until 1920, when he was appointed head of the research laboratory of Wallpaper Manufacturers Ltd. He took a similar post in 1926 at the Bleachers' Association Ltd. In 1931 he became a consultant and research chemist to Crosland & Pickstone Ltd, Bury, a post which held until his retirement. (*A.* 1922, *F.* 1926). *D.* 19.1.61.

Denis Kirby. *B.* 7.10.08. *Ed.* Loughborough College, 1927–32. B.Sc. (Lond.). He joined the Morgan Crucible Co. Ltd in 1933, and after a period in the chemical laboratory moved to the refractories department, where he served the company in a variety of capacities. In 1949 he was transferred to the newly-formed subsidiary Morgan Refractories Ltd where, from 1952, he was (sales) technical manager; in this capacity he was closely associated with the company's activities in supplying refractories for the glass industry. He was keenly interested in horticulture, motoring and all sports. (*A.* 1933, *F.* 1943). *D.* 10.11.60.

Arthur Marks. *B.* 21.7.1882. *Ed.* Municipal Technical School, Liverpool; Harris Institute, Preston; Royal College of Science and Royal School of Mines, London. He became a teacher of chemistry at the Gamble Institute, St Helens, from 1907 until 1912, when he was appointed head of the metallurgical and mining departments of the Technical College, Swansea. Thereafter he became successively in charge of the Chemical Division, National Physical Laboratory, 1914; chief of research and testing, Harland & Wolff Ltd, 1916; director of technical work, Bean Automobile Co., 1923; chemical engineer, Nitrate Association, Chile, 1926; chemical engineer and adviser, A. Harper, Sons & Bean Ltd, 1928; adviser in chemistry and metallurgy, American Petroleum Institute, New York, 1936; and electro-engineer, International Alloys Ltd, Slough, 1938. Later he became an investigator for the Lead Industries Development Council before setting up his own practice as a chemical, metallurgical and foundry consultant. (*A.* 1909, *F.* 1912). *D.* 16.11.60.

William Herbert Simmons. *B.* 24.5.1880. *Ed.* Grocers' Company's School; Finsbury Technical College; Birkbeck College; University College, London. B.Sc. He began his career as pupil and assistant to Dr S. Rideal, consulting chemist. In 1902 he joined the Vinolia Co. Ltd as an assistant chemist, becoming chief chemist in 1904. He was appointed research chemist to T. Morson & Son Ltd in 1907, and remained there until 1911, when he set up a private consulting practice, specializing in oils, fats and waxes, soaps and glycerine. He remained in control of the practice until his retirement in 1959. During the earlier years of his career, he was engaged in various other activities: as consulting chemist to Ozonair Ltd from 1906; as lecturer on soap manufacture, waxes and lubrication oils at Battersea Polytechnic from 1911; and as examiner in soap manufacture to the City and Guilds of London Institute in 1914. He was closely connected for many years with the Society of Public Analysts (now Society for Analytical Chemistry). He was the author of several papers in the *Analyst* and of *Soap: its Composition, Manufacture and Properties* (1917); with H. A. Appleton, *Handbook of Soap Manufacture* (1907); with C. A. Mitchell, *Edible Fats and Oils* (1911); and with G. H. Hurst, *Textile Soaps and Oils* (1913). 'He was highly respected by all who knew him. His main characteristics were complete loyalty to all persons and causes coupled with extreme modesty where his own achievements were concerned, and these qualities were ever embellished with gracious courtesy.' (*F.* 1917). *D.* 3.12.60.

Millicent Taylor. *B.* 17.10.1871. *Ed.* Cheltenham Ladies' College; University of Bristol, 1900–11. B.Sc. (Lond.), D.Sc. (Brist.). She was appointed head of the chemistry department at Cheltenham Ladies' College in 1894. During the First World War she worked for the Ministry of Munitions under Dr Harker at University College, London, and in 1917 was appointed a research chemist at H.M. Factory, Oldbury. She returned to her post at Cheltenham in 1919. The following year she was appointed demonstrator in chemistry at the University of Bristol, where she later became a research chemist. She was the author of a number of papers. (*A.* 1919, *F.* 1922). *D.* 23.12.60.

DEATHS

Fellows

(R) BAILEY, Walter George, B.SC.(EDIN.). Died 15 March, 1961, aged 62. *A.* 1923, *F.* 1944.

(F) DANNATT, Cecil William. Died 9 April, 1961, aged 68. *F.* 1936.

(S) FARRER, Thomas William, PH.D.(CANTAB.). Died 3 April, 1961, aged 33. *A.* 1951, *F.* 1954.

(SS) JEPSON, Clarence, M.SC.(MANC.). Died 12 April, 1961, aged 71. *A.* 1918, *F.* 1937.

(O) REID, Eric. Died 9 February, 1961, aged 58. *A.* 1926, *F.* 1930.

(P) ROBERTSON, John Douglas, D.SC., M.D.(ST AND.), PH.D., CH.B.(LOND.). Died 14 March, 1961, aged 57. *F.* 1945.

(V) TYLER, Ernest Albert, M.A.(CANTAB.). Died 5 April, 1961, aged 88. *F.* 1921.